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APPENDICITIS

DESCRIPTION OF FIGURE 1 (*Frontispiece*).

The surgical triangles of the right half of the abdomen and pelvis:

Upper Triangle.—Subdiaphragmatic peritonitis; hepatic lesions; pyloric lesions; pancreatic lesions; gall-bladder lesions; duodenal lesions; post-peritoneal neoplasms.

Middle Triangle.—Subdiaphragmatic peritonitis; hepatic lesions; empyema of the gall-bladder; post-peritoneal neoplasms; renal and ureteral lesions; upwardly displaced cecum and appendix; neoplasms of the hepatic flexure; intussusception; fecal impaction.

Lower Triangle (*above Iliac Spine*).—Appendicitis; peri- and para-typhlitis; fecal impaction; intussusception; carcinoma in ileo-cecal region; post-peritoneal neoplasms; osseous growths; abscesses originating in Pott's disease; floating kidney.

Lower Triangle (*below Iliac Spine*).—Appendicitis; osseous neoplasms; abscesses originating in Pott's disease; distended bladder; uterine neoplasms; ectopic gestation; inflammatory tubo-ovarian lesions; ovarian retention cysts and neoplasms; inguinal hernia; ectopic inflamed testicle.

A TREATISE

ON

APPENDICITIS

BY

GEORGE RYERSON FOWLER, M.D.

PROFESSOR OF SURGERY IN THE NEW YORK POLYCLINIC; EXAMINER IN SURGERY, MEDICAL EXAMINING BOARD OF THE REGENTS OF THE UNIVERSITY OF THE STATE OF NEW YORK; SURGEON TO THE METHODIST EPISCOPAL HOSPITAL; SURGEON-IN-CHIEF TO THE BROOKLYN HOSPITAL; SENIOR SURGEON TO THE GERMAN HOSPITAL; CONSULTING SURGEON TO ST. MARY'S HOSPITAL, THE RELIEF HOSPITAL, AND THE NORWEGIAN HOSPITAL; FELLOW OF THE NEW YORK SURGICAL SOCIETY; FELLOW OF THE AMERICAN SURGICAL ASSOCIATION; FELLOW OF THE NEW YORK ACADEMY OF MEDICINE; EX-PRESIDENT OF THE MEDICAL SOCIETY OF THE COUNTY OF KINGS; EX-PRESIDENT OF THE BROOKLYN SURGICAL SOCIETY

SECOND EDITION

REVISED AND ENLARGED

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TO THE MEMORY
OF
DR. ERNST KRACKOWIZER

IN GRATEFUL RECOGNITION OF
VALUABLE AID RENDERED TO ME
EARLY IN MY PROFESSIONAL CAREER
AS WELL AS IN ADMIRATION OF
HIS MANY NOBLE QUALITIES AS A
MAN AND HIS SKILL AS A SURGEON

THIS BOOK IS INSCRIBED

32977

PREFACE TO THE SECOND EDITION.

In presenting a second edition of this book I have endeavored to bring the subject of the inflammatory lesions of the vermiform appendix up to the present state of knowledge. Professional interest in these lesions has not diminished, but rather increased, since the publication of the first edition. This circumstance, together with the fact that the latter has been so favorably received, decided me to comply with the request of the publishers to furnish the material for a second edition.

It will be noted that much of the book has been rewritten, several chapters recast, and two new chapters added. In my experience with the operative treatment of these lesions, I have been struck with the difficulties attending the differential diagnosis even by physicians of acknowledged ability and repute. I have endeavored, in one of the new chapters, to so systematize available knowledge of lesions likely to be mistaken for appendicitis as to assist the practitioner at arriving at a conclusion in doubtful cases in as early a stage of the disease as possible, in order that prompt operative interference may be instituted at a time when the best results may be looked for.

Realizing the fact that, in the very nature of things, some cases of appendicitis must of necessity receive non-operative treatment at some stage of the disease, and that occasionally cases must be treated during their entire course by so-called medical methods, a chapter has been devoted to this phase of the subject.

Observations of a pathological nature have been incorporated in the chapter upon the "Inflammatory Lesions of the Vermiform Appendix." The material furnished by Professor Van Cott in his original report and conclusions upon specimens from cases in my own practice, and which were published in the first edition, have been made use of. Some of the facts brought out in this original report were, at that time, entirely new, and still remain undisputed.

Appendicular lesions due to foreign bodies, and inflammatory affections of the cecum, both of which bear a close clinical relation to the subject in hand, have been considered in a special chapter.

Operative methods have advanced, and, consequently, some of the older ones have been abandoned and new ones substituted. An endeavor has been made to assist the reader's understanding of the surgical anatomy and operative procedures by the introduction of illustrations from drawings from nature by Mr. Deck, intended to elucidate this branch of the subject.

My thanks are especially due to my medical friends for opportunities afforded me for conducting the studies upon which the clinical portion of this work is almost entirely based, by placing an exceptionally large number of operative cases in my care, and to my assistants in my hospital work for aid given me in utilizing this clinical material.

NEW YORK CITY,
BOROUGH OF BROOKLYN,
302 Washington Avenue,
August, 1900.

PREFACE TO THE FIRST EDITION.

The following chapters constitute a revised and corrected reprint of a series of articles which appeared in the ANNALS OF SURGERY under the title of "Observations upon Appendicitis."

The relation of the vermiform appendix to certain inflammatory conditions in the neighborhood of the cecum has been the source of careful and extended study on the part of surgeons during the last few years, this being comparable, to a certain extent, to the interest manifested at the beginning of the present decade in the inflammatory lesions of the Fallopian tubes and their consequences, when careful study of these brought out the truths which relegated to the musty pathology of the past such indefinite terms as "parametritis" and "perimetritis," as well as "pelvic abscess," and substituted therefor salpingitis and pyosalpinx. The interest awakened in appendical lesions, constituting as they do the most important inflammatory conditions of the abdominal cavity, in the male at least, has led to a steadily-increasing demand for definite knowledge of this, so far as known, useless organ and its diseases.

Exceptionally favorable opportunities have been afforded me, both in hospital and private practice, of observing the disease now known as appendicitis in its different forms. With the hope of shedding some light upon what has been, until quite recently, one of the darkest chapters in surgical pathology, as well as to offer such observations upon the management of the affection as have been suggested as the result of a personal experience covering now nearly two hundred cases of the disease, the present work has been undertaken.

The chapter upon the "Pathological Anatomy of the Appendix Vermiformis" is the work of Professor J. M. Van Cott, Jr. I desire also to express my obligations to Dr. Ezra C. Wilson, director of the Bacteriological Department of the Hoagland Laboratory, for valuable assistance in the preparation of the chapter upon "Bacteriological Considerations," and to Dr. H. B. Delatour for collating the original notes of the series of cases in my hospital service upon which the present study is largely based, and preparing the index.

The lithographic illustrations are from colored sketches of the fresh specimen made immediately after removal by Mr. F. A. Deck.

BROOKLYN,
302 Washington Avenue,
June, 1894.

TABLE OF CONTENTS.

CHAPTER I.

PAGE

ANATOMICAL CONSIDERATIONS 17

CHAPTER II.

THE INFLAMMATORY LESIONS OF THE APPENDIX 36

CHAPTER III.

ACUTE APPENDICITIS, CLINICAL HISTORY............................ 47

CHAPTER IV.

SPECIAL TYPES OF APPENDICITIS.................................... 58

CHAPTER V.

COMPLICATIONS OF APPENDICITIS 62

CHAPTER VI.

THE ETIOLOGY OF APPENDICITIS..................................... 72

CHAPTER VII.

BACTERIOLOGICAL CONSIDERATIONS 82

CHAPTER VIII.

THE DIAGNOSIS OF APPENDICITIS.......... 90

CHAPTER IX.

THE DIFFERENTIAL DIAGNOSIS OF APPENDICITIS..................... 102

CHAPTER X.

THE PROGNOSIS OF APPENDICITIS 124

CHAPTER XI.

PAGE
THE NON-OPERATIVE TREATMENT OF APPENDICITIS 132

CHAPTER XII.

THE TREATMENT OF THE COMPLICATIONS OF APPENDICITIS 137

CHAPTER XIII.

THE OPERATIVE TREATMENT OF APPENDICITIS 144

CHAPTER XIV.

THE AFTER-TREATMENT OF APPENDICITIS 199

CHAPTER XV.

APPENDICULAR LESIONS FROM FOREIGN BODIES; TYPHLITIS, PERITYPHLITIS AND PARATYPHLITIC ABSCESS 215

LIST OF ILLUSTRATIONS.

FIG.		PAGE
1.	The surgical triangles of the right half of the abdomen and pelvis.	*Frontispiece.*
2.	A transverse horizontal section through the pelvis at the level of the anterior superior spinous process of the ilium and sacro-vertebral angle	18
3.	Antero-posterior vertical section at the site of the ascending colon	19
4.	Appendix attached to the inner and posterior aspect of the bowel	20
5.	Fetal type of appendix	20
6.	Appendix attached between two bulging sacculi of the cecum	21
7.	Appendix attached at a point posterior to the inferior angle of junction of the ileum with the cecum	21
8.	Section of the vermiform appendix	24
9.	Showing Dr. Bristow's method of classifying the position and direction of the appendix	27
10.	Showing the different positions of the vermiform appendix	29
11.	Enterolith from the vermiform appendix	72
12.	The intact mucous membrane lining of an appendix, the outer walls having sloughed away, showing a coprolith in position	74
13.	Cystic dilatation of the appendix	96
14.	The aponeurosis of the external oblique	148
15.	The internal oblique muscle	149
16.	The transversalis and posterior lamella of the sheath of the rectus muscle	149
17.	Section of the abdominal wall in the lumbar region, showing the division of the aponeurosis of the internal oblique to form the sheath of the rectus muscle	150
18.	The transversalis muscle, deep epigastric artery and veins, and the eleventh and twelfth intercostal nerves	150
19.	Intersecting lines showing the surface relations of the base of the appendix vermiformis	152
20.	Förster's portable Trendelenburg table	154
21.	Förster's table folded for transportation	154
22.	Delatour's portable operating-table	155
23.	Delatour's portable operating-table in the Trendelenburg position	155
24.	Delatour's portable operating-table folded for transportation	156
25.	Cleveland's ligature carrier	160
26.	Ligature crutch	160
27.	Modified Hagedorn needle	161

FIG. PAGE
28. Asparagus-boiler for sterilizing purposes.... 162
29. The incisions for operations on the appendix 171
30. The aponeurosis of the external oblique as it appears in the oblique incision 172
31. The operation by the oblique incision. Incision of the aponeurosis of the external oblique 172
32. The internal oblique as it appears in the oblique incision.... 173
33. Incision of the internal oblique and sheath of the rectus muscle.... 173
34. The transversalis as it appears in the oblique incision.... 175
35. The peritoneum as it appears in the oblique incision.... 175
36. The peritoneum drawn through the opening in the transversalis.... 176
37. The incision in the peritoneum 176
38. The author's intermuscular method. The aponeurosis of the external oblique exposed. The dotted line shows the place for the incision in this structure 178
39. The author's intermuscular method. The internal oblique exposed. Dotted line shows the site of the incision in the sheath of the rectus muscle 178
40. The author's intermuscular method. The anterior lamella of the sheath of the rectus retracted. The dotted line shows the site of the transverse incision 179
41. The author's intermuscular method. The opening in the abdomen.... 179
42. The vertical incision. The aponeurosis of the external oblique where it blends with the anterior lamella of the sheath of the rectus muscle. Dotted line showing the site of the incision to open the sheath of the rectus.... 181
43. The vertical incision. The rectus muscle drawn toward the median line. Dotted line showing the site of the incision behind the muscle to enter the abdominal cavity.... 181
44. Self-retaining retractor 183
45. The cecum turned upward and forward and brought outside the abdominal cavity, and resting upon a gauze compress. The meso-appendix ligated 187
46. The meso-appendix divided and detached from the appendix. The purse-string suture applied 187
47. Amputation of the appendix by means of the thermo-cautery. A square of folded gauze is so placed as to protect the parts from the heat of the cautery 187
48. Inversion of the edges of the opening in the cecal wall at the site of the amputated appendix.... 187
49. The serous surfaces of the cecal wall at the site of the amputated appendix approximated by tightening the purse-string suture.... 188
50. Method of securing the silkworm-gut to the needle 194
51. The first step of the removable layer suture. Method of securing approximation of the peritoneal surfaces.... 195
52. The second step of the removable layer suture. The peritoneal surfaces in process of approximation.... 195

FIG. PAGE
53. The third step of the removable layer suture. The suture ends are again reversed and passed through the skin. They are then arranged in pairs and the bolsters placed in position. The dotted line upon the upper right-hand bolster shows the manner of passing the ends of the silkworm-gut through the lumen of the tubing.................... 195
54. The removable layer suture. Appearance of the parts with the sutures drawn taut 195
55. The bolsters "set" and the sutures tied. The skin edges in course of closure by the intracuticular suture 196
56. Suture of the transverse incision in the author's intermuscular method. 197
57. Suture of the aponeurosis of the external oblique in the author's intermuscular method.. 197
58. The relative size and shape of the skin incision when closed by the intracuticular suture... 198

PLATES.

FRONTISPIECE.

The surgical triangles of the right half of the abdomen and pelvis.

PLATE I (page 22).

Appendix with distal third of lumen obliterated by lymphoid tissue.

PLATE II (page 36).

Simple Appendicitis.

PLATE III (page 37).

FIG. 1. Photograph of normal appendix with its meso-appendix intact, from a child.

Fig. 2. Photograph of an appendix, the seat of recurrent inflammation, to which is attached the major portion of the meso-appendix.

PLATE IV (page 38).

FIG. 1. Camera drawing of a transection of a nerve in the meso-appendix of a chronic relapsing appendicitis.

FIG. 2. Camera drawing of nerve in transection, also from the hyperplastic meso-appendix of chronic appendicitis.

PLATE V (page 40)

Camera drawings of transections of vessels in the meso-appendix of two cases of chronic appendicitis, and the submucosa of another, in which the process is much younger.

FIG. 1. Arteriole from an area of coagulation necrosis in a hyperplastic meso-appendix.

FIG. 2. Sclerosed arteriole, containing thrombus in granular degeneration.

FIG. 3. Arteriole from the submucosa of an appendix in which an acute attack supervened without perforation.

PLATE VI (page 41).

Distal end of appendix, gangrenous and perforated.

PLATE VII (page 42).

Chronic relapsing appendicitis with stenosis of the lumen.

PLATE VIII (page 54).

Acute appendicitis with gangrene of the mucous membrane and perforation.

PLATE IX (page 61).

Appendix showing minimum amount of damage inflicted after several attacks, the last attack occurring two weeks before the operation.

PLATE X (page 73).

Appendicitis with gangrenous perforation.

PLATE XI (page 76).

Acute appendicitis. Stenosis of the appendix following former attacks.

PLATE XII (page 106).

Appendix perforated within twenty-four hours of the first symptoms. No foreign body or fecal concretion present.

PLATE XIII (page 126).

Appendix post-peritoneally situated for the greater portion of its length.

A TREATISE ON APPENDICITIS.

CHAPTER I.

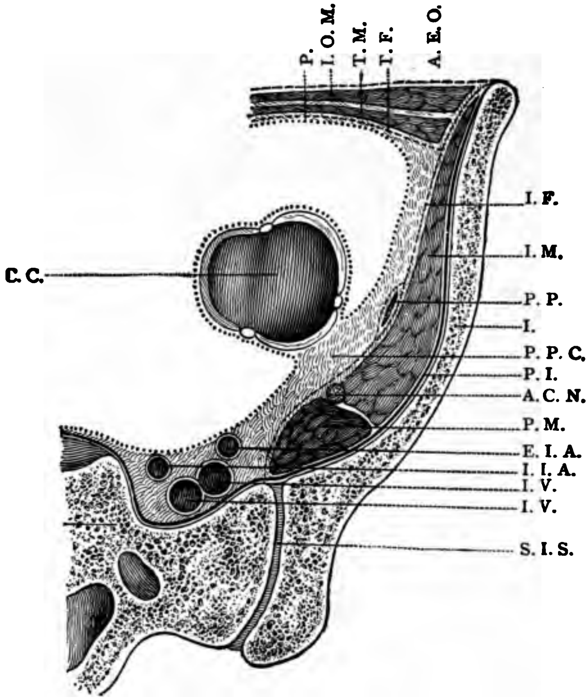
ANATOMICAL CONSIDERATIONS.

The **caput cecum coli** is the large blind pouch which represents the initial portion of the colon. It is usually defined as that portion of the latter which lies below the level of the ileo-cecal valve. Its cavity measures somewhat more in the transverse than in the vertical diameter, being about two and a half inches in length by three inches in breadth. Its usual location is in the right iliac region, lying upon the psoas magnus muscle, and its most dependent point or apex projects just beyond the inner edge of that muscle. This corresponds, externally, to a point slightly to the inner side of the middle of Poupart's ligament.

Occasionally the cecum will be found external to the psoas, and lying upon the iliacus muscle in the right iliac fossa; or the bulk of the caput may lie upon the latter muscle, while the apex rests upon the psoas. Again, the cecum may hang over the pelvic brim entirely clear of these structures, or be lodged within the cavity of the true pelvis. After the second month of intrauterine life, the cecum gradually recedes from the neighborhood of the umbilicus, which is its original position, and finally becomes fixed in the right iliac fossa. Instances of non-descent of the cecum are not as infrequent as is generally supposed.

The condition of the cecum will determine, to some extent, its relation to the surrounding parts. Thus, when distended, it may occupy the entire right iliac fossa, crowding the small intestine toward the median line. In the empty state, on the other hand, it is covered by loops of the small intestine, or these may even reach to its outer side.

FIG. 2.



A transverse horizontal section through the pelvis at the level of the anterior superior spinous process of the ilium and sacro-vertebral angle.

Right Side.—Lower segment of the section. Adult male (after Tillaux).

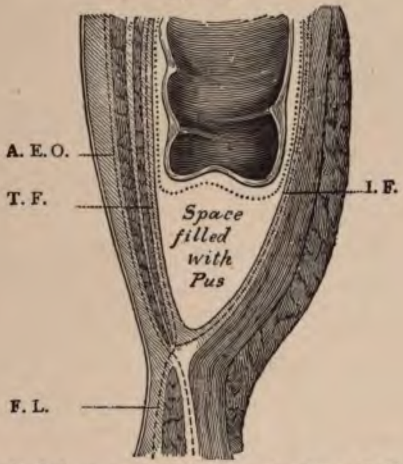
C. C., caput coli; P., peritoneum (dotted line); I. O. M., internal oblique muscle; T. M., transversalis muscle; T. F., transversalis fascia (broken line); A. E. O., aponeurosis of the external oblique muscle (broken line); I. F., iliac fascia (broken line); I. M., iliacus muscle; P. P., psoas parvus; I., ileum; P. P. C., post-peritoneal connective tissue; P. I., periosteum of the ilium; A. C. N., anterior crural nerve; P. M., psoas magnus; E. I. A., external iliac artery; I. I. A., internal iliac artery; I. V., iliac veins; S. I. S., sacro-iliac symphysis; S., sacrum.

The direction of the cecum is not in a straight line with the otherwise vertically placed ascending colon, but is somewhat obliquely placed from above downward and to the left.

The cecum is maintained in its position in the right iliac fossa by the posterior reflection of the peritoneum, leaving a variable portion of the posterior surface of this part of the large intestine applied against the iliac fascia, with more or less connective tissue (the retro-cecal connective tissue) between (Fig. 2). When a true mesocecum exists, this serves to connect the portion of the large intestine with the right iliac fossa.

The topographical anatomy of the cecum, particularly with reference to its relations to the retro-cecal and post-peritoneal connective tissue, as well as the large vessels in the neighborhood, is of importance in connection with the inflammatory lesions of and operations upon the vermiform appendix. If a transverse and horizontal section be made through the iliac fossa upon a level with the anterior superior spinous process of the ilium and the sacro-vertebral angle, the average relative position of these parts in the adult will appear as shown in Figure 2.

FIG. 3.



A. E. O., aponeurosis of the external oblique (broken line); T. F., transversalis fascia; F. L., fascia lata (broken line); I. F., iliac fascia (broken line).

Purulent collection shown crowding the peritoneum (dotted line) in an upward direction, and limited below by the junction of the iliac fascia and the transversalis fascia at the crural arch (after Tillaux).

The relation of the retro-cecal and post-peritoneal connective tissue is of especial importance in those cases of appendicular abscess in which the appendix is only partially covered by peritoneum. Under these circumstances infection of the structures above named gives rise to a true iliac phlegmon (Grisolle). The suppurative process develops beneath the peritoneum and crowds that structure in an upward direction, as well as anteriorly. There is thus formed in the iliac fossa a collection of purulent material situated sub-peritoneally, the boundaries of which are as follows: In front, the transversalis fascia prevents its further progress in that direction, while the iliac fascia limits it posteriorly. The crural arch forms its boundary inferiorly.

Fig. 4.

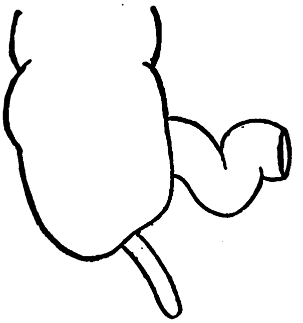
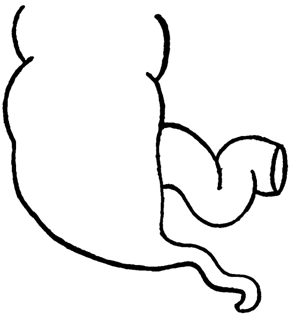


Fig. 5.



If the pus be not evacuated early, it may find its way into the general cavity of the peritoneum by a process of ulceration, after crowding this structure in an upward direction, as shown by the dotted line in Figure 3.

The passage of the external iliac artery and vein through the post-peritoneal connective tissue which forms the inner limit of the iliac fossa, offers an opportunity for the purulent collection to follow the sheath of these vessels and to make its appearance upon the anterior and inner aspect of the thigh. This occurs somewhat rarely in appendicitis, although one such case has come under my observation.

The appendix vermiformis ceci is an atrophied organ, the rudimentary remnant of the lengthened cecum found in all mammalia except man and some of the higher quadrumana. It is also found in the wombat. It is usually attached to what was originally the apex of the cecum, close to the ileo-cecal valve on the inner and posterior side of the bowel (Fig. 4). Exceptionally the fetal type persists, in which case the appendix may become a continuation of the long axis of the colon (Fig. 5). In another form, the appendix appears between two bulging sacculi (Fig. 6);

or, in still another, the root of the appendix is posterior to the inferior angle of junction of the ileum with the cecum (Treves), (Fig. 7).[1]

Instances of non-descent of the cecum result in a corresponding abnormal situation of the appendix; the latter has even

FIG. 6.

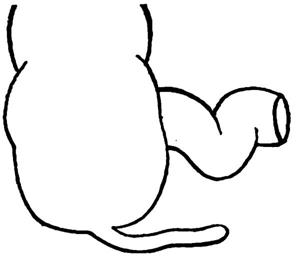
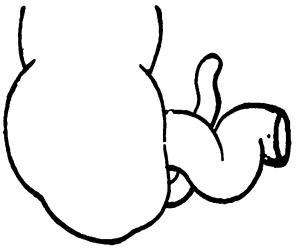


FIG. 7.



been found lying to the left of the median line. Lennander mentions having observed, in a dissection of a sixteen-year-old boy, the cecum, together with an appendix nine inches long, lying against the spleen in the left hypochondriac region.[2]

The length of the appendix varies from one to nine and a half inches; the average length is three and one-half inches. Its diameter is that of a goose-quill. When a meso-appendix is present, this comes off from the left layer of the mesentery of the ileum, with which, together with the points of its attachment to the appendix, it forms two sides of a triangle; the third side of the triangle is formed by the free border of the meso-appendix. In 200 cadavers examined by Ferguson, of Toronto,[3] the appendix in 100 cases was found to have a mesentery of its own. In the adult the mesentery extends from one-third to two-thirds of the length of the appendix, and a fringe-like prolongation reaches from this point to the tip of the organ. This is composed of two peritoneal layers, forming a fold between which considerable fat is sometimes deposited. This fold may sometimes enclose the iliac vessels as well. In the female the meso-appendix has a prolongation which is lost in the broad ligament; this is described by Clado as the appendiculo-ovarian ligament.[1]

---

[1] These variations depend upon the greater or lesser relative development of the dextral wall of the cecum.

[2] Sammlung klinischer Vorträge, No. 75, August, 1893.

[3] American Journal of the Medical Sciences, January, 1891.

The shape of the appendix varies greatly. It may be perfectly straight, particularly where the mesentery is very short or absent. The fact that the mesentery is frequently too short for the organ often gives the latter a curved shape. Shortening of more than one portion of the mesentery may give to the appendix a lateral curve, a succession of curves, or a cork-screw (periwinkle) shape.

The structure of the appendix is similar to that of the large intestine, but is not identical with it. From without inward are to be found the following layers:

(1) The peritoneal investment of the organ. The completeness with which this covers the organ varies greatly. Sometimes it is entirely covered, as a finger is covered by a glove; in other instances it is but partially covered. The latter condition was found in more than one-quarter of the observations upon the subject which have been recorded, including those of Maurin, who, in the examination of 112 subjects, found the appendix in the entire number completely surrounded by peritoneum. In the remaining three-fourths the appendix was free in the peritoneal cavity. In those instances in which it is only partially covered by peritoneum, the uncovered portion, in the great majority of cases, is in direct contact with the post-peritoneal connective tissue. In rare instances the uncovered portion is in contact with the wall of the cecum, the same layer of peritoneum serving for both cecum and appendix.

(2) The muscular layer. This consists of a few long nonstriated muscular fibres, with which are mingled a varying amount of fibrous tissue, constituting the outer portion of the muscular layer. The inner part of the muscular coat forms the greater portion of the walls of the appendix. It consists mainly of fine fibrous with more or less muscular tissue, arranged in a circular manner. According to Austin Flint, circular muscular fibres do not exist in the appendix vermiformis.[2]

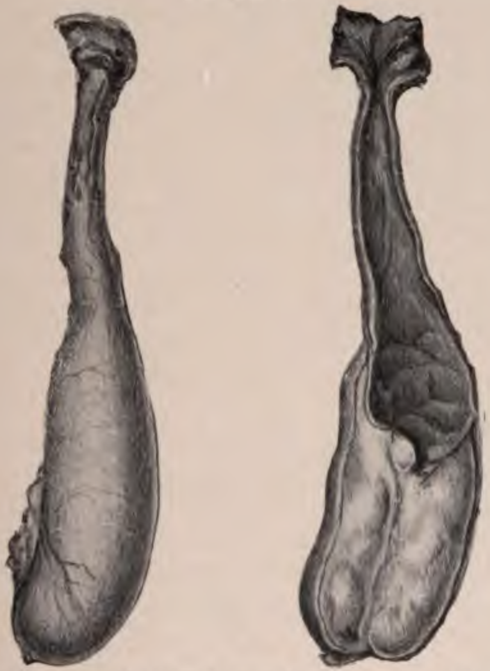
(3) A relatively thick layer of connective tissue, with arterial openings and lymphatic depressions—the submucosa.

---

[1] Société de Biologie, January 30, 1892; Revue de Chirurgie, March, 1892.

[2] Text-book on Human Physiology, New York, 1888, p. 258.

PLATE 1.



Appendix with distal third of lumen obliterated by lymphoid tissue.

(4) A mucous coat, having a thin muscularis mucosa, and lined with cylindrical epithelium. The mucosa contains tubular glands and closed follicles. According to Clado, glandular structure is also found in the walls of the appendix in small areas of adipose tissue. A duplicature of the cecal mucous membrane near the orifice of the appendix is sometimes described as a valve (Gerlach). This is not constant, and, even when present, forms but an incomplete valve.

The histological differences are as follows: The appendix is especially rich in lymphoid tissue, greatly resembling the tonsils in this respect. The proportion of lymphoid tissue may also vary greatly in different individuals and in different parts of the same appendix. In some instances it is almost entirely absent. It is, as a rule, most abundant in children, although it is not by any means absent in the aged. Frequently the lymphoid tissue projects beyond the level of the mucous membrane and encroaches upon the lumen of the organ (see Plate I). The mucous membrane itself is often built up of closely applied lymphoid cells, which are evidently undergoing the process of proliferation.[1] There is a decided preponderance of longitudinal fibres in the muscularis, the circular fibres being correspondingly lessened; in some instances the latter are absent.

The vermiform appendix has a central cavity or lumen, extending its entire length, which terminates in a *cul-de-sac* at its inferior or free extremity. The diameter of the central cavity is very small when compared with the thickness of its walls. The existence of a circular or semilunar shaped valve at the level of the cecal aspect of the appendiculo-cecal orifice, and which is supposed to guard the latter, is denied by Clado. Lafforgue identified it in two out of 200 dissections (Testut), and in both of these appendices fecal masses occupied the cavity of the organ. This observation throws considerable doubt upon the assertion that the valve of Gerlach serves as a barrier to the entrance of fecal matter or foreign bodies into the appendicular cavity.

The blood supply of the appendix is as follows: Anastomosis takes place between the superior mesenteric, ileo-colic, right colic, and middle colic arteries by means of arches, from which secondary loops are given off; from the latter an appendicular branch arises in connection with branches which supply the ileocecal region. This appendicular branch, the essential nutrient artery of the organ, passes along the free edge of the mesentery, giving off branches on its way. In case the mesentery is absent, the artery passes beneath the peritoneal coat of the appendix. In exceptional cases the vessel may pass directly to the tip of the organ, giving off no branches until it is reflected in the submucosa.

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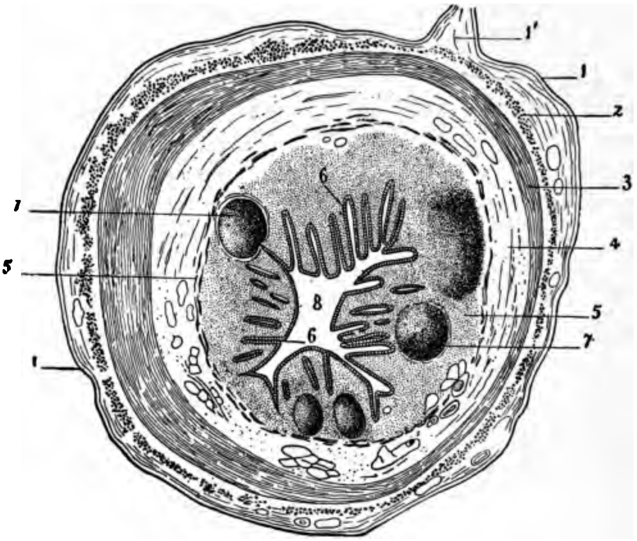
[1] A Contribution to the Pathology of the Vermiform Appendix. T. N. Kelynack, London, 1893.

FIG. 8.



Section of the vermiform appendix (after Testut).

1, peritoneal covering; 1¹, mesenteric attachment; 2, layer of longitudinal muscular fibres; 3, layer of circular fibres 4, submucosa; 5, mucous membrane; 5¹, muscularis mucosæ; 6, glands of Lieberkühn; 7-7, closed follicles; 8, cavity of the appendix.

With respect to the presence of blood-vessels it is to be noted that the circulation in the appendix is practically a terminal one, the distribution of the appendicular branch of the mesenteric artery admitting of but slight collateral circulation, and this mainly through continuity of structure with the cecum. In women a further source of supply is present through the vessels of the fold of peritoneum described by Clado as passing from the broad ligament to the meso-appendix, the so-called appendiculo-ovarian ligament.

The lymphatics of the appendix pass into the appendicular lymphatic ganglion, which lies in the angle formed by the appendix and the cecum (Clado). In the female, lymphatic channels pass along the appendiculo-ovarian ligament between the folds of the peritoneum which form this structure, and establish communication between the appendix and the ovary.

The nerves of the appendix are derived from the superior mesenteric plexus of the sympathetic nervous system. Filaments from the branch which accompanies the ileo-colic artery pass to the organ. It is to be noted that the superior mesenteric plexus is finally largely distributed to the small intestine. This explains the general dissemination of the pain in the abdominal region in cases of appendicitis.

The location of the appendix with relation to the cecum, as well as to the general abdominal cavity and its contents, is important to the surgeon at the present time, in view of the fact that the removal of the organ (appendicectomy) has become an operation of frequent occurrence. Turner, of Moscow,[1] has made a careful study of eighty-three cadavers, in which the appendix lay freely in the abdominal cavity, with the following results:

In fifty-one, it hung down in the lesser pelvis.

In twenty, it passed transversely over the psoas muscle toward the sacral promontory.

In six, it lay freely upon the iliacus or upon the psoas.

In two, it passed upward upon the lateral surface of the descending colon.

In three, it lay in the meso-gastric region, with the commencement of the colon, lying transversely.

In one, it lay in front of a right-sided sigmoid flexure.

In twenty-two cases in which the appendix lay behind the first portion of the colon, between this and the posterior abdominal wall, its relative position was as follows:

In four, it lay curled up behind the ileo-cecal junction.

In five, it lay directly behind the cecum.

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[1] Chirurgitchesky Vestnik, 1892, March and May; Centralblatt für Chirurgie, No. 41, 1892, p. 840.

In six, it passed intra-peritoneally along the posterior or postero-median surface of the colon.

In two, it passed in the same direction extra-peritoneally.

In four, it passed in the same direction, but only partly extra-peritoneally.

In one, the fundus of the cecum turned upward and backward, the appendix lying behind it.

Professor J. D. Bryant, of New York,[1] in a study of the location and direction of the appendix, based upon 144 dissections, gives the following tabulated statement.

DIRECTION OF THE APPENDIX.	MALE.	FEMALE.	NOT STATED.	TOTAL.
Inward	20	11	3	34
Behind the cecum	18	10	4	32
Downward and inward	16	7	5	28
Into the true pelvis	14	3	4	21
Downward	5	0	0	5
Upward and inward	4	5	0	9
Upward and backward	3	0	0	3
Upward and outward	2	0	0	2
Outward	1	1	0	2
Upward along the inner side of the colon to liver	1	0	0	1
Upward outside of ascending colon and cecum	1	3	0	4
Curled below the cecum	1	0	0	1
Downward and outward	0	0	1	1
Upward and back of the cecum and colon	0	0	1	1
Totals	86	40	18	144

Dr. A. T. Bristow, one of my assistants at St. Mary's Hospital, has suggested a simple method of classifying the position and direction of the appendix. It consists in locating a central point in the right iliac fossa, and, from this as a centre, drawing lines radiating in the different directions that the appendix assumes, and representing its attachment to the cecum by the above-mentioned central point. The radiating lines are indicated by numbers. I have modified this method by substituting the initial letters of the points of the compass for the numbers. A reference to the accompanying figure will show the application of the method. The line WE is drawn transversely to the median line of the body, and tangentically to the base of the cecum when in its normal situation. From the point where the cecum touches this line, the appendix may take any one of eight different directions, indicated respectively by the radiating lines W, NW, N, NE, E, SE, S, SW (Fig. 9).

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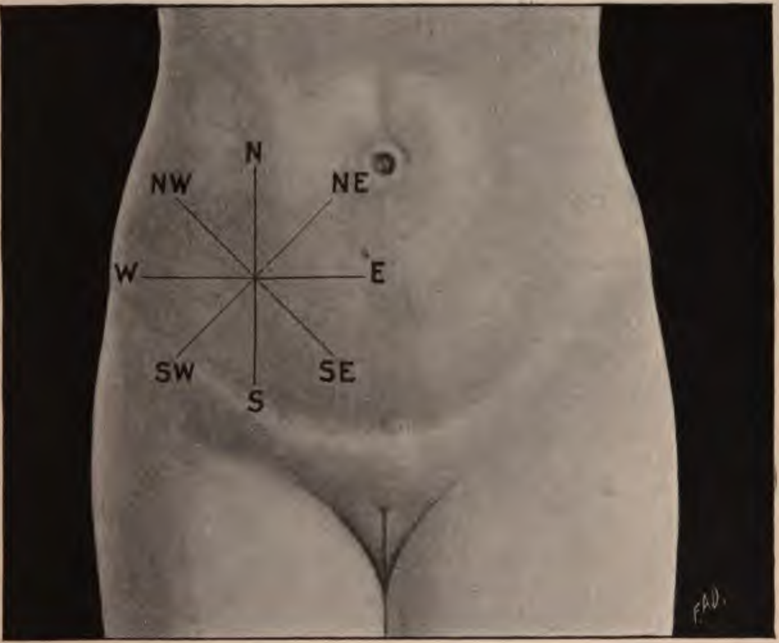
[1] Annals of Surgery, February, 1893, page 164.

FIG. 9.



Appendices arising from colons abnormally placed form a class by themselves.

The appendix may pass either above or below the transverse line W-E. When above, it may take any one of the three general directions indicated by NW, N and NE. If below the transverse line, it may in like manner take any one of the downward directions indicated by the lines SW, S or SE. It may also run directly outward in the W direction, or directly inward in the E direction. When it takes the N line it will usually lie behind the colon, although it may exceptionally take this direction anterior to the ascending colon. When the appendix takes the general direction E, if sufficiently long, it may cross both iliac vessels and appear in the left iliac fossa, where its presence may give rise to left-sided appendicitis. If the organ presents a decided inclination toward either the anterior or posterior abdominal wall, in either of these positions, the initial V (ventral) in the case of the former, or D (dorsal) in the case of the latter, may be added.

When the direction of the appendix is SE, it very frequently passes across the vessels into the true pelvis. This point should be borne in mind when a differential diagnosis is to be made between appendicitis occurring in the female, and inflammatory conditions of the pelvic organs.

Adopting this method of classification and study, Dr. Bristow[1] reports the following as the position and direction of forty appendices in dissecting-room subjects:

CLASS A. COLON NORMALLY PLACED.

(1) Appendix above the transverse line:
Line NW, 1; line N, 9; line NE, 0; total 10.
(2) Appendix parallel with the transverse line:
Line W, 0; line E, 4; total 4.
(3) Appendix below the transverse line:
Line SW, 2; line S, 6; line SE, 16; (not into pelvis, 1; into pelvis, 15); total 24.
Total number in Class A, 38.

Of these, one appendix, proceeding in the direction E, reached across to the left side, just beneath the linea semilunaris; one in the direction of N just touched the liver.

CLASS B. COLON ABNORMALLY PLACED.

In the pelvis, 1; in the scrotum, 1. In each case the appendix lay behind the displaced colon.

M. Lafforgue's studies upon the relative frequency of these positions, as based upon 200 dissections of subjects at all ages of both sexes, gives the following results:[2]

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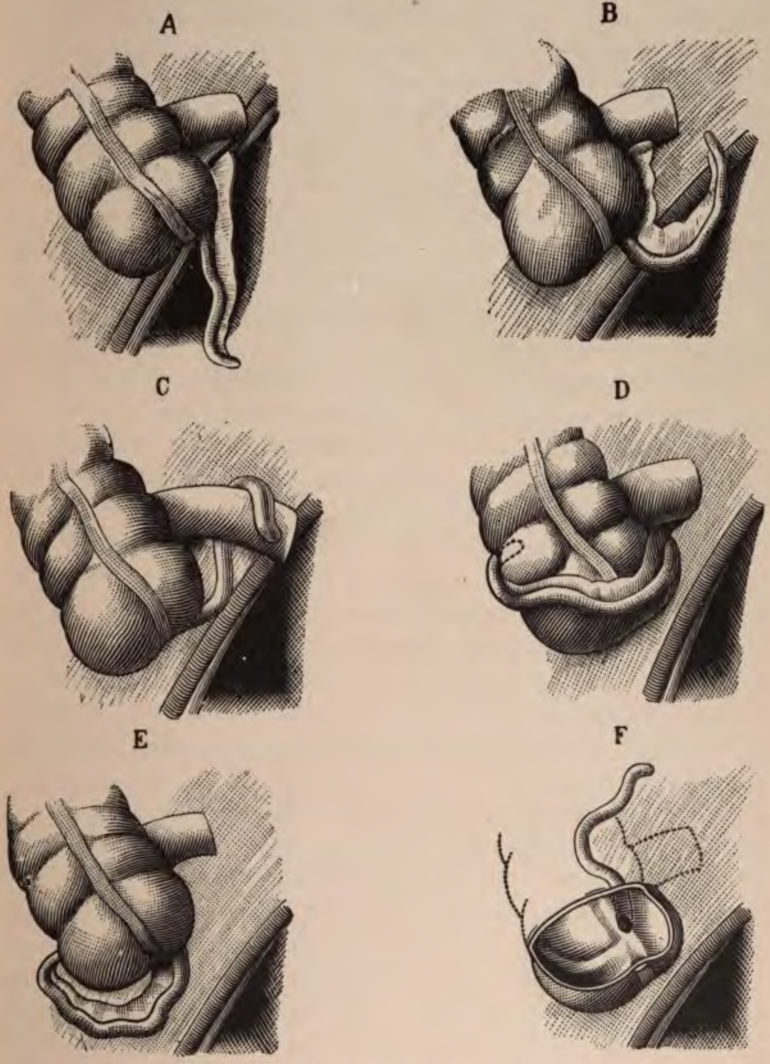
[1] Meeting of the Brooklyn Surgical Society, April 6, 1893.

[2] Traité d'Anatomie Humaine, par L. Testut, Tome Troisième, 2e Fascicule, p. 543. Paris, 1893.

Fig. 10



Showing the different positions of the vermiform appendix (after Testut).

A, downward; B, inward; C, inward, coiled about the ileum; D, outward, crossing in front of the cecum; E, outward, upon the iliac fascia; F, upward, behind the cecum and colon.

In a downward direction, 41.5 per cent.; laterally, in an outward direction, 26 per cent.; laterally, in an inward direction, 17 per cent.; in an upward direction, 13 per cent.

Practically speaking, the appendix has four cardinal directions,—viz., (1) in a downward direction; (2) in a direction inward; (3) directly outward; and (4) in an upward direction. When it passes in the downward direction, in the great majority of cases the appendix crosses the psoas muscle and iliac vessels (A, Fig. 10) and enters the pelvis, where it is brought into relation with the bladder and rectum in the male, and in addition to these, in the female, with the uterus and right ovary.

In assuming the inward direction (B, Fig. 10) the appendix is brought into relation with the coils of small intestine and may even extend beyond the boundaries of the rectus abdominis muscle of the opposite side. Usually it runs parallel with that portion of the ileum which is adjacent to the ileo-cecal valve. Occasionally it is coiled about the ileum, at this point near the junction of the latter with the cecum (C, Fig. 10). In this situation, during an attack of inflammation, the appendix, by becoming attached at its tip to its own mesentery, may act as a constricting band and produce strangulation of the intestine.

When it passes in an external direction, it either crosses in front of the cecum, thus partially encircling the latter (D, Fig. 10), or it curves below the cecal ampulla (E, Fig. 10) and lies upon that portion of the iliac fascia which invests the iliacus internus muscle.

When it passes in an upward direction, it is attached to the posterior surface of the cecum (F, Fig. 10), and may extend behind the colon to the level of the kidney or even reach to the liver. A long appendix is generally less tortuous in its course than a short one.[1]

The anatomic disposition of the appendix is occasionally such as to favor the occurrence of a pathological anastomosis through ulcerative action between its lumen and the cavity of the cecum. In this class belong those instances in which the organ passes upward behind the cecum, with its body applied directly to the wall of the latter, with no serosa between, the latter investing the appendix and the cecum in the same layer. Under these circumstances a perforation of the appendix at the place where it is appended to the cecum may be followed either by an ulceration and perforation of the latter and a communication between this and the appendix, or, in the event of the formation of an appendical abscess, an evacuation of this into the bowel will be favored.

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[1] The appendix does not assume the same direction at all times in the same individual.

Those who in former times were disposed to attribute to the appendix some important function based their views upon the fact that the organ was so attached to the cecum as to avoid the most dependent part of the latter, and was so located behind this, the pouch-shaped extremity of the colon, as to be out of the way of injurious influences, as well as to avoid the possibilities of the production of strangulation of intestine. Further, the supposed prevailing obliquely upward direction, which it was believed was intended to prevent the entrance therein of fecal matter and foreign bodies, thereby assisting the action of the valve-shaped folds of cecal mucous membrane placed at its orifice or point of communication with the cecum, was urged in support of this theory. It is now known, however, that, as far as its position and origin are concerned, these, at least, are the natural result of developmental changes, involving, in intrauterine life, the forward and downward enlargement of the cecum. A diverticulum of the same width as the colon is at first formed; this widens out to form the cecum from a portion of the former, the lower part of the latter remaining as the comparatively narrow appendix. This at first presents a funnel-shaped communication with the large intestine (see Fig. 5). The broad base, however, gradually narrows before birth, although the appendix enlarges after birth. It increases in length and width actually, but becomes smaller relatively as the individual grows older. In other words, the appendix of an infant is larger, proportionately to the cecum, than that of an adult.

The fact that the appendix vermiformis is provided with follicles both open and closed, like those of the cecum, has suggested some function in connection with these. This is met, however, with the argument that, if further glandular apparatus were needed at this point, the addition of a half inch more of cecum would accomplish the purpose without the risk involved in the present arrangement. The presence of the closed glands or lymphoid follicles in the walls of the blind and narrow tube constituting this organ is believed to be of great pathological importance; a more dangerous morphological combination could scarcely be devised.

Investigations, therefore, upon the subject of the vermiform appendix only serve to emphasize the fact that, not only is it a useless organ, but a most dangerous one as well. The science and natural theology of but a few decades ago held the view that every species was of independent origin, and every structure designed for use in the organism within which it occurs. The student of comparative anatomy, however, whose studies extend beyond the domain of a single species will realize that there are structures in the animal economy the presence of which cannot be accounted for or function demonstrated by the study of these in their relation to the organism within which they occur.[1]

The only course at all likely to throw light upon the vermiform appendix and its presence in man is by the study of the comparative anatomy of the cecum. This organ presents the greatest possible variation in the different species, in some of which it is of great length and enormous capacity, with the evident purpose of fulfilling an important function in connection with the processes of digestion and absorption. In man, as is well known, it is comparatively short, while in the otter, hedgehog and bat there is no abrupt distinction to be noted, externally, between the large and small intestine.

As a familiar instance of a largely developed cecum may be mentioned the rabbit. In this animal the cecum is very long and capacious, being about the length of the animal, and of a capacity about ten times greater than the animal's stomach. The distal two and a half inches, or that part which is present beyond the spirally sacculated portion of the long cecum, has been compared to an appendix vermiformis. This portion is somewhat tapering in shape, the diameter gradually diminishing from about half an inch where it commences, to three-eighths of an inch at its extremity. This portion is not sacculated; its walls are thicker than those of the remainder of the cecum, and the latter are said to be the seat of a large number of closed glands or lymphoid follicles. This so-called appendix can scarcely be denominated a narrow tube, however, in the rabbit, for the reason that in this animal it is really wider than the small intestine by an appreciable amount. A similar arrangement exists in certain vegetable-feeding marsupials, except that in these the appendicular portion of the cecum is proportionately longer.

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[1] Professor John Struthers, Edinburgh Medical Journal, December, 1893, p. 489.

In certain long-tailed monkeys the ileum, colon and cecum closely resemble, in their arrangement and disposition, these parts in man, except that there is a progressive diminution in size of the large intestine from the ileo-cecal region to the anus. The size of the entire digestive tract, although much smaller than in man, is larger in proportion to the size of the animal than in the human subject. A dissection of one of these reveals the following:[1]

The large intestine, including the cecum, colon and rectum, measures sixteen inches in length. The colon, exclusive of the cecum, varied considerably in width at varying portions of the canal. At the level of the junction of the ileum with the cecum it was one inch in width; at two inches above this point the width was three-fourths of an inch; in the middle of the transverse colon it measured one inch; at the commencement of the descending colon it measured one-half an inch; at the sigmoid flexure it measured three-eighths of an inch. The rectum, just above the anal orifice, was but a quarter of an inch in width. The cecum itself measured one and a quarter inches in width. The width of the ileum at the point where it joined the large intestine was three-eighths of an inch.

The entire large intestine, commencing at a point one and a half inches below the ileo-cecal junction, is irregularly sacculated. It is made up of the usual large and small pouches, held together by the longitudinal bands and intestinal portion of the mesocolic attachments. At a point one and a half inches below the attachment of the ileum the sacculated condition suddenly ceases, from which point the intestine proceeds for a distance of threequarters of an inch to a smooth and somewhat conical termination.

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[1] Specimen loaned by Dr. Eliza M. Mosher, whose courtesy is hereby acknowledged.

But two longitudinal bands are present at the cecal extremity of the large intestine, the anterior and antero-lateral. Here and there, near the line of attachment of the meso-colon to the intestine, there is a suggestion of a third band. Both bands are considerably widened at their cecal commencement as compared with their width elsewhere.

These longitudinal bands do not extend to the end of the large and smooth pouch, which represents the termination of the cecum, but are lost at a point corresponding to one and a half inches below the ileo-cecal junction, this being the exact point where the sacculated portion ceases.

A meso-colon is present, and likewise a meso-cecum. The latter ceases at the level where the longitudinal bands and sacculated portions of the large intestine cease. A triangular-shaped fold of peritoneum is given off from the last inch and a quarter of the ileum, which passes over and is attached to a corresponding part of the terminating portion of the large intestine. This fold fills the angle below, formed by the junction of the ileum with the colon. As it extends downward upon that portion of the cecum below the point at which both the sacculi and longitudinal bands cease, it occupies almost exactly the location, as well as strongly resembles, the human meso-appendix.

The portion of the cecum below the sacculi and termination of the longitudinal bands is somewhat analogous to the condition of this portion of the large intestine, as it exists in early intra-uterine life in the human fetus. The smooth pouch, as distinguished from the more sharply defined and multiple sacculation which represents the remainder of the cecum, the rather abrupt termination of the longitudinal bands at this point, as well as the presence of the triangular-shaped mesenteric fold existing in the angle between the cecum and the last inch and a quarter of the ileum, all seem to suggest that the lower portion of this unusually long cecum is really appendicular in character, and forms that portion of the large intestine which, in the course of evolutionary changes, becomes vermiform. By processes of contraction and condensation the lower portion of the cecum assumes the shape which is found in the human subject. Its open glands and lymphoid follicles do not disappear in the course of these evolutionary changes, but are crowded more and more closely together, and hence become much more numerous, in proportion to the area which they occupy, than elsewhere in the intestine.

CHAPTER II.

THE INFLAMMATORY LESIONS OF THE APPENDIX.

Definition.—The inflammatory lesions of the appendix were formerly comprehended under the terms typhlitis, peri-typhlitis and para-typhlitis. Typhlitis was defined as an inflammation of the cecum itself (Albers); the second indicated an inflammation of the parts immediately surrounding the cecum (Goldbeck); while the third was used to designate an inflammation of the post-peritoneal connective tissue of the cecum (Oppolzer). At the present time, thanks to the writings of Fitz, of Boston, and of Weir and McBurney, of New York, these diseases are known to be due to lesions which, in the great majority of cases, occur primarily in the appendix, and extend thence to the peritoneal investment of the organ or to the post-peritoneal tissue in the neighborhood.

To Grisolle is due the credit of having persistently opposed the teachings of Albers regarding the pathology of these affections. The views of the latter have found their way, however, into almost every text-book published since 1839 in which the subject has been discussed, while the true pathology of the disease now known as appendicitis, although ably set forth by Grisolle[1] in the same year, was disregarded for more than half a century until brought to light and verified by the American observers just mentioned.

Grisolle contended that simple inflammation of the mucous membrane of the cecum could scarcely give rise to the grave consequences involved in the phlegmonous inflammatory conditions as they occur in the right iliac fossa, since dysenteric and other well-recognized forms of ulceration of the same structures show no tendency to extend into the neighboring connective tissue. On the other hand, inflammation of the vermiform appendix of the cecum, followed by perforation, phlegmonous inflammation, and abscess in the right iliac fossa, explained in a rational manner the course of

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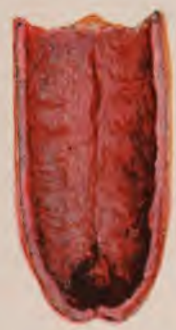
[1] Tumeurs phlegmoneuses des fosses iliaques, Archives de Médecine, 1839.

PLATE II



Simple appendicitis.

DESCRIPTION OF PLATE III.

Fig. 1.—Photograph of normal appendix vermiformis with its meso-appendix intact; from a child aged fourteen years.

(1) Meso-appendical artery and vein, coursing the free border of the meso-appendix. (2) Straight vessels given off from these to the appendix, which supply a dense plexus of minute vessels to the meso-appendix, a system of perforating vessels to the four coats of the appendix, and a superficial plexus to the serous coat of the same. (3) Dense net-work of fine vessels,—arterioles and venules, which are in the connective tissue of the meso-appendix, and everywhere accompanied by trophic nerves. The figure demonstrates clearly the terminal nature of the circulation.

Fig. 2. Photograph of an appendix, the seat of recurrent inflammation, which has attached to it the major portion of its meso-appendix. This latter—the extent of which is marked by 4, 4^1—is everywhere hyperplastic, containing a large amount of adventitious white fibrous and adipose tissues.

5 marks a distended annular portion of the appendix, the coats of which are thin and atrophic.

5^1 marks an annular area which shows exactly the reverse of this condition, the coats being thickened and contracted.

6 marks another area resembling 5, which has finally perforated.

There is a small amount of fresh lymph over the serous surface of the appendix and upon the meso-appendix.

Inspection of Fig. 1 makes it clear how torsion of the meso-appendix can readily produce localized oligemia when severe, and vascular stasis when only sufficient to obstruct capillary and venous return; while inspection of Fig. 2 would seem to show the inevitable effect of chronic productive inflammation and the resulting mechanical interference with the circulation.

PLATE III.

FIG. 1.

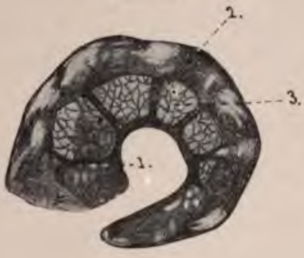
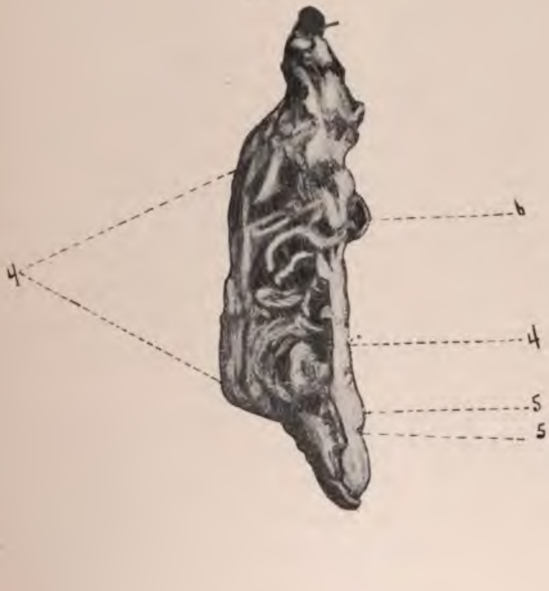


FIG. 2.



events as they actually took place; moreover, the explanation was verified by investigations carried out in the dead-house. The views of Albers were purely artificial and speculative, while those of Grisolle were based upon accurate anatomico-pathological researches.

The term "typhlo-enteritis," introduced by Burne, is equally objectionable as being misleading; this writer suggested that the term be applied to inflammation of the cecum and of the appendix as well.

The term "iliac phlegmon" simply implies one of the sequences of the disease, and in the light of our present knowledge should also be rejected.

The possible appearance, though as a rare affection, of a genuine "stercoral typhlitis" is still maintained by Lennander. The occurrence of fecal stasis giving rise to an inflammatory paresis of the cecum, thus increasing the stagnation of the intestinal contents, and this in turn increasing the resistance offered by the inflammatory conditions, are supposed to be the pathological sequences involved in its occurrence. This view is opposed by Professor Sahli.[1] Unfortunately, abscesses which might be supposed to have their origin in this manner are simply evacuated, the appendix, in all probability the cause of the trouble, in many instances being entirely disregarded. A case of intestinal obstruction observed by Lennander[2] indicates the possibility of its occurrence.

In view of the prominent part that the appendix takes in the affections formerly embraced under these names, it is deemed advisable to discard altogether the terms "typhlitis," "peri-typhlitis" and "para-typhlitis," as well as "typhlo-enteritis," as applied to the conditions usually met with, and to substitute for all of these the term "appendicitis" when speaking of the disease under discussion.

Pathology.—The fact of the vestigial origin of the vermiform appendix, and of the consequent presence of a relatively larger proportion of lymphoid tissue, is of importance in connection with the pathology of the inflammatory lesions of the organ, for the reason that it is believed that its low vital resistance is to be attributed to these. Further than this there is no reason for supposing that this portion of the anatomy is not subject to the pathological laws which govern tissues in general.

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[1] Korresp. Blatt für Schweizer Aerzte, 1892, s. 593–611.

[2] Sammlung klinischer Vorträge, No. 75, 1893.

General Anomalies of Formation.—These, as well as the influences which they exert upon the occurrence of the disease appendicitis, have already been dwelt upon in the chapter on anatomical considerations. In this connection it will suffice to call attention to the dangers involved in the presence of an organ of low vitality in situations where it is exposed to injurious influences resulting from permanent lodgement of fecal matter, as well as foreign bodies, within its lumen, together with the most favorable opportunities possible for infection of its tissues.

Circulatory Disturbances.—These consist of oligemia and hyperemia, and are dependent upon the same causes which underlie like conditions elsewhere. That they are peculiarly liable to occur in the appendix is due to the great mobility of the organ and its mesentery, and the mechanical disturbances, such as torsion and angulation, to which it is subject.

Non-Specific Inflammations.—These are due to the presence of the several pyogenic micro-organisms, and constitute by far the most important portion of the study of the pathology of appendicitis. They are divided, as in the case of similar lesions elsewhere, into catarrhal, purulent and fibrinous, these occurring either separately or in combination. In addition to these we have to deal with the interstitial variety.

Specific Inflammations.—These differ from the last named in that the micro-organisms, upon which they depend, possess specific pathologic properties. In this group are included the inflammatory conditions resulting from the presence of the tubercle bacillus and the typhoid bacillus.

Nutrition Disturbances.—These are divided into those of a progressive and those of a regressive character. The first named include consecutive hyperplasia of one or all of the tissues. The regressive nutrition-disturbances include atrophic changes from deficient vascular or nervous supply; these likewise may involve any or all of its coats.

Foreign Bodies.—The role which foreign bodies may play, when present, is undoubted. In this are included abrasions of the

DESCRIPTION OF PLATE IV.

Fig. 1.—Camera drawing of a transection of a nerve in the hyperplastic meso-appendix of a chronic relapsing appendicitis.

Zeiss Apochromat. Sys. Oc. 4, Obj. 4 mm. Scale, .010 mm. ÷ 10.

a.—Granulo-hyaline exudate thrown out between the perineurium and nerve-fibres, and seen to contain certain large granular epithelioid elements.

a^1.—Thickened perineurium, composed of hyperplastic connective tissue.

b.—Nerve-bundle, showing a diffuse endoneuritis, and extensive atrophy of the nerve-fibres, which appear compressed by exudate.

Fig. 2.—Camera drawing of nerve in transection, also from the hyperplastic meso-appendix of chronic appendicitis.

Conditions of drawing similar to Fig. 1.

a.a^1.—*Peri- and endo-neural connective-tissue hyperplasia.*

b.—Wide-spread nerve atrophy.

PLATE IV.

FIG. 1.

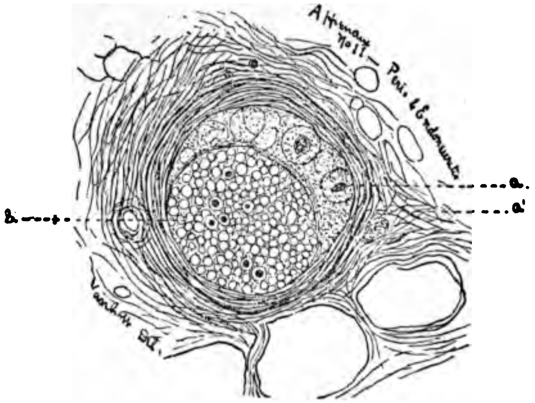
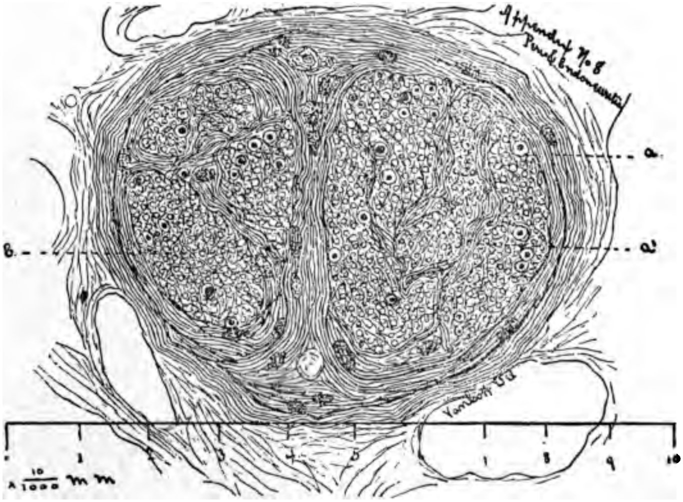


FIG. 2.



mucosa and loss of protection of its epithelial covering, and infection and its consequences (see chapter xv).

Parasites.—These include the various intestinal micro-organisms. A discussion of the part which these take in the production of the inflammatory lesions of the appendix will be found in chapter vii.

The specimens removed from a series of thirteen consecutive cases of appendicitis occurring in my hospital practice, these representing the various types as well as different stages, were submitted to Professor J. M. Van Cott for examination.[1] In all the specimens examined the presence of some form of obstruction to the blood current in the meso-appendix was demonstrated, these consisting of either para-, peri-, or endo-vasculitis, or organized thrombus. These conditions, as pointed out by Professor Van Cott, may have long preceded the round-celled infiltration, the coagulation necrosis and purulent foci present in the walls of the appendices themselves (Plate V). In several of the cases evidences of chronic interstitial neuritis of the nerves of the meso-appendix were also observed, these leading to atrophy of the nerve fibres.

The effects of these lesions of vessels and nerves, whether preceding or following infection of the tissues, is such as to produce the most profound trophic disturbances of the organ itself, with consequent lessened vital resistance, and finally localized necrosis.

Another source of trophic disturbance was found in the specimens examined, namely, the existence of progressive hyperplasia of the coats of the appendix. This is probably due to repeated hyperemia or chronic stasis through interference with the return circulation in the meso-appendix, and results eventually in the vascular and nervous lesions above alluded to. Finally, there can be no question that the presence of foreign bodies in the lumen of the appendix, when these are of a character to produce local pressure, as well as angulation of the appendix, is followed by necrosis of the mucous membrane and consequent infection.

A study of the specimens from cases of subacute and chronic relapsing appendicitis, taken in connection with the history of these cases, makes it probable that bacterial infection does not necessarily occur in the first or in any subsequent attack in which recovery takes place without rapidly destructive processes. The clinical course in many of these cases is marked by an absence of fever and other evidences of infection, and the gross and microscopical appearances of the organ after removal suggest that vascular and nervous lesions in the meso-appendix precede the development of the changes in the appendix itself and produce the latter, on the one hand, or that angulation, or pressure exercised upon the organ by an overfilled colon, the appendix lying either posteriorly or between this portion of the large intestine and the lateral abdominal wall, on the other, leads to repeated hyperemia or chronic stasis through defective venous return in the meso-appendix. Progressive hyperplasia in the coats of the appendix results, which, in its turn, is followed by the vascular and nervous lesions found in the cases under study, until, finally, a sufficiently pronounced lessening of the local vital resistance to establish a vulnerable point for bacterial invasion and infection occurs, a rapidly progressive destructive process, with proportionate grave symptoms, characterizing the attack.

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[1] Professor Van Cott's conclusions as based upon the examination of these cases were published in full in the first edition of this work.

Adhesions the result of repeated relapses are constantly found in these cases. These may fix the appendix in a position to still further embarrass its circulation. The presence of the adhesions themselves, irrespective of this effect, will modify the nutrition of an organ in which disturbances of this character are so easily established, and pave the way for more decided vulnerability. In this manner not only is the supervention of dangerous attacks of the disease invited, but fresh dangers assail the patient from the operative stand-point, these arising from the increased difficulties encountered, and hence greater risks involved, in removing the appendix.

The links in the pathological chain, therefore, leading up to the conditions as found in appendicitis, comprise changes in the vessels and nerves of the parts, and consequent interference with the nutrition of the organ and its mesentery, and lessening of its vital resistance,—and finally bacterial invasion with its disastrous consequences upon structures whose very presence in the organism, owing to their vestigial character and consequent low vital resistance, is a menace to the individual. Finally, it can never be known, in

DESCRIPTION OF PLATE V.

FIGS. 1, 2, 3.—Camera drawings of transections of vessels in the meso-appendix of two cases of chronic appendicitis, and the submucosa of another, in which the process is much younger.

Conditions of drawings similar to those of Plate IV.

FIG. 1.—Arteriole from an area of coagulation necrosis in a hyperplastic meso-appendix; acute exudative appendicitis having been superinduced on the chronic lesion by perforation.

a.—Greatly reduced lumen of vessel.

a^1.—Hyperplastic endothelium of intima.

The whole vessel shows characteristic changes due to coagulation necrosis.

FIG. 2.—Sclerosed arteriole, containing thrombus in granular degeneration, *a*, in the centre of which is a white cell.

a^1.—Thickened intima, with hyaline infiltration.

a^{11}.—Fibroid degeneration of media. The whole vessel is reduced in size, the lumen small, irregular, eccentric, while the coats are thickened.

FIG. 3.—Arteriole from the submucosa of an appendix in which an acute attack supervened without perforation; only intense hyperemia and dulling of serosa being visible. The meso-appendix was in the early stage of hyperplasia, and the seat of considerable small round-cell infiltration. This vessel is an exquisite example of endarteritis obliterans. The smaller vessels of the submucosa in this case were many of them far advanced in sclerosis, and there are small foci of intense, small round-cell infiltration and necrosis in the mucosa,—miliary abscess (?).

a.—Very small, irregular, and eccentric lumen.

a^1.—Irregularly thickened intima at the circumference of which is a layer of yellow elastic tissue.

a^{11}.—Media showing moderate small round-cell infiltration, and an early stage of fibroid degeneration.

In this case evidently a process is commencing, the later stages of which are shown in the appendices of 1 and 2; and the case is just such an one in which repeated attacks with recovery (?) may occur, until the final perforation with severe consequences takes place.

PLATE V.

FIG. 1.

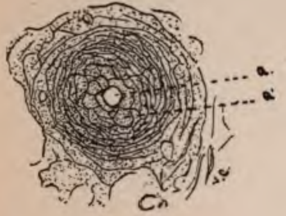


FIG. 2.

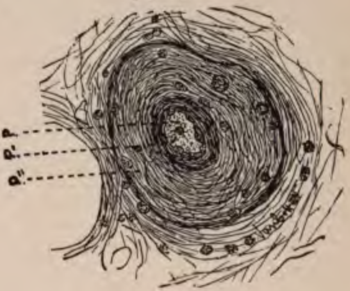


FIG. 3.

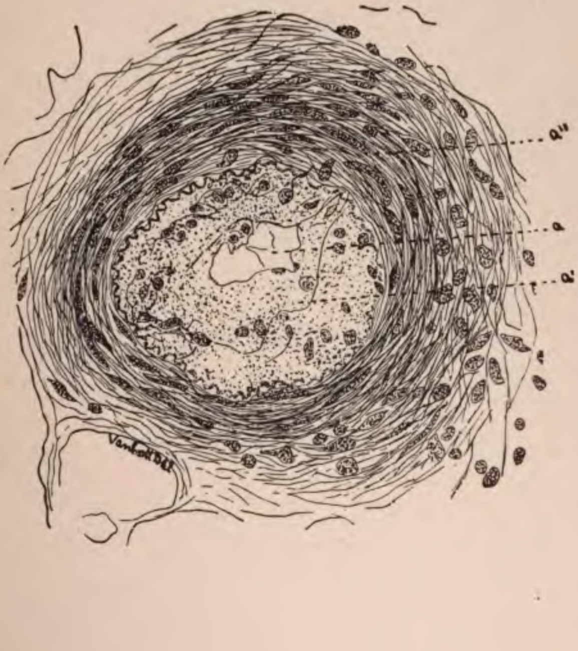
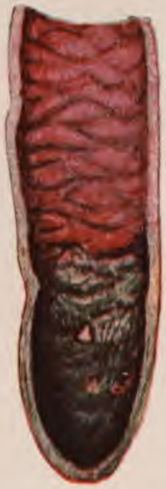


PLATE VI.



Distal end of appendix, gangrenous and perforated.

a given case, whether an acute attack is the result of sudden torsion, angulation, the presence of a foreign body, or, as first pointed out by Van Cott, the first warning of a chronic productive meso-appendicitis, with progressive trophic lesions of the appendix.

STAGES.

For the purposes of our study of the processes involved in these lesions, it is convenient to divide the disease into the following-named stages, but the fact is always to be borne in mind that these stages may merge imperceptibly into one another, and that one or more stages may be, and usually are, present at the same time.

FIRST STAGE.—**Endo-Appendicitis.**—In this stage a more or less intense inflammation of the mucous membrane and submucosa occurs. The attack may advance no further than this stage. It corresponds to the stage of "appendicular colic," as described by Talamon,[1] and covers a period of about twenty-four hours. Talamon states that this stage is ordinarily prolonged from two to three days, and that it covers the period of the engagement of a stercoral calculus in the appendix. This is probably an error. I have more than once performed appendicectomy during the first forty-eight hours of the existence of the disease, and have never found evidences of this engagement of a coprolith at the cecal orifice of the appendix. On the contrary, I have frequently failed to find even soft fecal masses within the appendix. Usually the most indubitable evidences of endo-appendicitis, parietal appendicitis, or peri-appendicitis, or all three, are found even at this early period.

While it is true that this stage may represent only a so-called catarrhal inflammation, many undoubtedly make the error of considering the condition as one of slight importance. In addition to the fact that the disease may run through all four stages within three days, and the first three stages within forty-eight hours, there are especially dangerous conditions that may supervene, or accidents that may occur, even when the inflammation seeems to be limited to the mucosa and submucosa.

The first of these dangers is the occurrence of constriction of some portion of the tube by the swelling of the mucous membrane and of the submucous connective tissue. The parts first involved in the inflammation advance the most rapidly to the stage of engorgement and infiltration. As a result of this a constriction of the lumen of the appendix occurs at one or more points, the effect of which is to imprison within what is now practically a closed cavity the mucus resulting from the hypersecretion of the inflamed mucous membrane, together with whatever fecal matter there happens to be within the tube. As a further complication of this stage the pressure effects of the infiltrated connective-tissue spaces of the submucosa from without, and the accumulated secretion from within, should not be lost sight of. The appendix, like other vestigial structures in the animal economy which have ceased to functionate as a result of evolutionary changes, possesses but slight vital resistance. Interference with its blood supply to an extent that in other organs would be of but minor importance here produces the most disastrous consequences. These include necrosis of the mucosa, which invites rapid bacterial infection of the walls of the appendix; ulcerative destruction of a circumscribed character, which in its turn leads to a perforation from the presence of accumulated and retained mucus and muco-pus; finally, gangrene of a portion or of the whole of the organ may develop.

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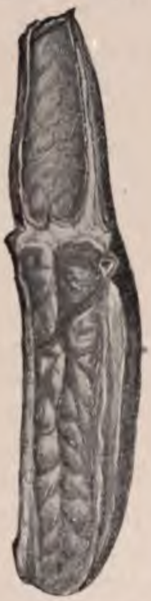
[1] Appendicite et Pérityphlite par Ch. Talamon, Paris, 1892.

Gangrenous inflammation may likewise result from a direct occlusion of the nutrient vessels of the body of the organ. As a result of an infection of the submucosa an endarteritis or phlebitis, having their origin from the paravascular connective-tissue spaces, occurs; the endothelial lining of the vessel then becomes roughened and thickened, and a stasis thrombosis follows. Or endarteritis obliterans of the vessels of the meso-appendix and changes in the trophic fibres of the nerves of the latter may precede, for a considerable time, the occurrence of infection. Certain anatomical peculiarities of the vessels themselves may favor the production of the gangrenous condition. For instance, it may happen that but a single nutrient artery exists, and that this may not give off any branches before reaching the tip of the appendix, being there reflected upon itself in the submucosa. This condition was found to exist in one of my cases: a stasis thrombosis of septic origin occupied the lumen of the vessel at a point about one-third of the distance which the vessel traversed from the tip to the base

PLATE VII.



Chronic relapsing appendicitis with stenosis of the lumen.

of the organ. Endo-appendicitis, engorgement of the vessels of the mucosa, capillary stasis, necro-biological changes in the mucosa, infection of the submucosa, endarteritis and thrombosis were all found to have taken place within ten hours following the first symptom of the disease. Under these circumstances the primary inflammatory lesion occurs in the peripheral portion of the organ, and the occlusion of the vessel takes place at this point; following this a gangrenous condition will supervene in the portion of the appendix lying between the point of occlusion and the base, since there is no other blood supply save through the reflected trunk.

SECOND STAGE.—**Parietal Appendicitis.**—This stage is characterized by an inflammatory process, whose seat is in the interstitial or intermuscular structure of the body of the appendix. It is analogous to the corporeal metritis of the gynecologists. It presents in its simplest form an ordinary serous inflammation, with engorgement of the vessels and the presence of an exudate in the perivascular spaces. The infection may take place through the submucosa or through the lymphatic channels leading directly from the mucous membrane. As a result of circulatory disturbances (endarteritis obliterans), one or more circumscribed points of ulcerative action may develop, involving both the mucous lining and the peritoneal investment, and leading to perforation; or from interstitial pressure strangulation may occur in addition, and complete gangrene of the organ may follow.

Again, suppurative inflammation may occur in parietal appendicitis in the form of a rapidly spreading phlegmonous inflammatory process or several circumscribed points of suppuration the result of septic embolism. In this manner several foci of suppuration may make their appearance simultaneously.

THIRD STAGE.—**Peri-Appendicitis.**—A further step in the pathological process involved in this disease consists of an infection and consequent involvement in the inflammatory process of the peritoneum which invests the appendix. The limitation of the peritoneal infection to that portion of the serous membrane which covers the organ, with the occurrence of adhesions between the appendix and the serous surfaces immediately adjacent, mark the boundaries of this stage.

FOURTH STAGE.—**Para-Appendicitis.**—In this stage the most serious consequences, arising from the presence of the disease, manifest themselves, although the dangers of the affection, as we have already seen, are by no means limited to this period. Following the formation of adhesions, infection of the fibrino-plastic exudate constituting these may take place, either through the lymph-channels of the appendix, from perforation of the walls of the latter and infection from the walls of the tube, or by direct infection from one or more of the foci of suppuration in the walls of the appendix. Thus it may happen that, upon opening into an appendicular sero-purulent collection or abscess, the result of a para-appendicitis, the appendix may be found either perforated or intact.

Para-appendicular abscess, arising from suppurative inflammation in the retro-peritoneal connective tissue with which the uncovered portion of the appendix comes in contact, in cases where the organ is extra-peritoneally situated in whole or in part, also occurs in this stage of the disease.

Infection of the retro-peritoneal connective tissue, or of the mass of adhesions, or of both, in either of the ways above described, results in the occurrence of a suppurative inflammation within these. The suppuration may be limited to the adhesions themselves and remain distinctly circumscribed, or it may assume a spreading, phlegmonous character here, as well as in the retro-peritoneal connective tissue. In the first instance, a sero-purulent collection forms; in the second, an abscess occurs with limiting walls, beyond which the peritoneal surfaces remain comparatively healthy (the "iliac phlegmon" of the older writers). With the formation of a spreading or phlegmonous inflammation the case is different. Here one of three things may result: First, a diffused peritonitis may take place from septic infection, though the serous effusion following this need not necessarily become purulent. Second, a general suppurative peritonitis may occur from pyogenic infection of the serous effusion. Micro-organisms from within the intestine, which, under certain circumstances, may become exceedingly virulent, find their way to the seat of the effusion through the usual channels of infection. In all probability these micro-organisms are themselves the infective agents which produce both the appendicitis and the peritonitis. The serum finally becomes a culture medium for the bacteria, and as a result of this a rapidly progressive suppurative process develops, followed by general septic infection. Third, secondary, encysted intra-peritoneal foci of suppuration may form. Here a serous effusion may occur beyond the limits of the original para-appendicitis due to indirect or lymphatic infection. The serum subsequently undergoes suppurative changes.

It should be stated, in passing, that the occurrence of septic peritonitis, either diffused non-suppurative, diffused suppurative or intra-peritoneal and encysted, is not necessarily limited to the fourth stage or deferred till the formation of adhesions. From the first appearance of an endo-appendicitis, channels of infection are opened which may lead to the occurrence of any one, or of all of the forms of septic peritonitis, without the occurrence of perforation, formation of adhesions or rupture of a sero-purulent collection or an abscess cavity.

The term "para-appendicitis" is sometimes employed to designate suppurative inflammation of the connective tissue adjacent to that portion of the appendix which is not covered with peritoneum, when this anatomical condition exists. Inasmuch as this condition is exceptional, while suppurative inflammation of the connective tissue and inflammatory new formation about the appendix is of very common occurrence, the term is here employed as a convenient one to designate both conditions. In the case of the connective tissue, ordinary pus is produced, while in the case of the mass of adhesions, an intra-peritoneal sero-purulent collection results.

Circumscribed inflammatory processes within the peritoneum do not, as a rule, show the same tendency to spread from the very beginning as do those occurring extra-peritoneally. In the case of the latter the entire plane of connective tissue of the dorso-lumbar region may become rapidly infected, and as a result of this lumbar phlegmon a subphrenic or a paranephritic abscess may arise from lesions of the appendix.

In pursuing the study of the clinical history of the disease, it becomes at once apparent that it presents itself with different degrees of severity, from the acute form on the one hand, the different stages of which have just been discussed (the hyperacute form of Talamon), to the subacute form on the other, with its slight febrile action and moderate abdominal pain and tenderness. In addition to these, there are different phases of the disease to be noted clinically. These consist of the recurrent form and of the chronic form, which in its turn may lead to the relapsing variety.

CHAPTER III.

ACUTE APPENDICITIS. CLINICAL HISTORY.

In the great majority of cases the clinical course of the disease is characterized at the outset by the occurrence of acute abdominal pain. While the term "appendicular colic" (Talamon) has been given to this acute pain, I consider this misleading, and liable to give rise to indifference on the part of the medical attendant to the true conditions present and the dangers which threaten the patient. The term "colic" has been generally applied to purely functional disturbances of the large and small intestines; the acute pains of appendicitis are due, on the contrary, to an inflammatory condition, which may rapidly involve the entire organ and place the patient's life in the greatest jeopardy. If the colic be of appendicular origin, an appendicitis in one of its forms is already in progress.

The view that the "colic" is produced by an attempt on the part of the appendix to rid itself of fecal matter which has found its way into the tube is refuted by the frequency with which fecal matter, sometimes even in the shape of coproliths, is found post-mortem in cases in which no colic had occurred; and by the fact that as a rule no circular muscular fibres are present in the appendix, or when present are in insufficient quantity—hence efforts at expulsion would be very feeble in character, and not calculated to give rise to the violent pains characteristic of the first stage of appendicitis.[1]

The attempt to compare the mechanism of the production of pain during the first stage of an attack of appendicitis to that which takes place in the initial stage of a hepatic, or of a nephritic colic, by supposing that a hard mass of fecal matter engages in the orifice of the tube is equally fallacious. In the case of hepatic or of nephritic colic the offending body is either a gall-stone or a uric acid or oxalate of lime calculus, and there can be no question as to the ease with which these may produce local as well as radiating pains, with constitutional disturbances. In the case of the appendix the pains cannot be explained in this manner. Here the fecal matter, when present, is so soft as to be readily crushed between the thumb and finger, as I have repeatedly demonstrated to visitors at my clinics. The presence of these soft fecal masses in appendices exposed in laparotomies done for other purposes, which can be readily felt upon palpation, and to which I have often called the attention of my assistants, also effectually disposes of the fancied similarity between an attack of appendicitis and an attack of renal or of hepatic colic, even if the entire absence of fecal concretions and other foreign bodies in a large proportion of cases of the disease under discussion was not of itself sufficient.

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[1] Professor Austin Flint is authority for the statement that there are no circular muscular fibres in the appendix, while Kelynack asserts that they are present in varying amounts. Their presence, according to Professor Van Cott, is frequently demonstrable.

In view of these facts, therefore, the sudden occurrence of sharp colicky pains should always direct the attention of the practitioner to the appendix vermiformis, and a watchful care should be exercised over this apparently useless, and certainly treacherous, organ.

The location of the primary pain is usually referred to the neighborhood of the umbilicus. Next in frequency it is complained of in the epigastrium, very infrequently in the region below the umbilicus, and least frequently of all is it referred to the appendix itself. With the advance of the disease, and the occurrence of localized peritonitis, the pain is referred, in addition, to the right iliac fossa, or at this stage the latter may be the sole seat of the pain. The fact that the pain is so seldom located about the cecum in the commencement of the disease is, in a large measure, responsible for many errors which have been made in the diagnosis.

It is difficult to find a suitable explanation of this peculiar phenomenon. I have observed, however, in a case of artificial anus involving the cecum and the first two inches of the ileum, that the application of the compressing enterotome of Dupuytren produced the same acute pains referred to the region of the umbilicus. Bacon, of New Haven, in a case in which he was compelled to remove the appendix under cocaine anesthesia, remarked that the patient complained of pain about the umbilicus when the organ was grasped by a pair of forceps. In the case of the compressing enterotome the pain was doubtless produced by the blades of the instrument grasping the base of the appendix, as one of these passed into the cecum, and the other into the ileum. When the blades were readjusted, and passed in an upward and inward direction, away from the appendix, relief of the peri-umbilical pain followed.

Coincidently with the attack of pain, or shortly thereafter, nausea and vomiting frequently occur. The appearance of these symptoms, in connection with pain about the umbilicus, is significant, in spite of the generally received opinion that the nausea and vomiting are only such as are frequently observed in ordinary attacks of acute indigestion, and which usher in many of the acute diseases. Even where indigestion and intestinal colic, the latter a comparatively rare affection in the disease, in my experience, are responsible for the nausea and vomiting, the nausea is more apt to precede than to follow the colicky pains, as in appendicitis. The vomiting is a purely reflex symptom, due to an irritation having its origin in the appendix.

The vomiting is rarely persistent during the initial stage of the disease. It usually ceases when the contents of the stomach are evacuated, but may return with the occurrence of perforation of the appendix, rupture of an encysted sero-purulent collection or of an appendicular abscess, or the condition of intestinal paresis. If nausea alone is present, it is rare for it to last beyond the first two or three hours of the disease. The character of the vomiting in cases where it recurs after having once ceased will vary according to the conditions present. If coincident with primary perforation of the appendix itself, or following it, when no adhesions have formed, or with rupture of an appendicular abscess into the peritoneal cavity, the vomiting will be explosive, and the material evacuated from the stomach of the greenish serous character so common in diffuse septic peritonitis. In intestinal paresis stercoraceous material may be ejected, in addition, as a result of a reversed peristalsis. When the intestinal tube is emptied, serous fluid which has gained access to the intestine from

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the peritoneal cavity by endosmosis will be ejected more or less stained by its passage along the intestine (fecaloid vomiting). During the first stage of the disease the patient may swallow more or less fluid without necessarily provoking vomiting, or even increasing the nausea. The vomiting which occurs in connection with perforation differs from this in that it is prolonged, incessant, and repeated, and is aggravated or provoked by any attempts to take medicine, or even small quantities of food or liquids.

Constipation may precede or accompany the attack. Obstinate constipation occurring in connection with the commencement of the attack is indicative of early intestinal paresis, and should be a warning to the attendant that he has to deal with a more than usually grave form of the affection. When this symptom appears later in the course of the disease, its character does not differ from that which occurs in the course of peritonitis due to perforation from other causes. Finally, this symptom may assume all of the characteristics of the obstipation which accompanies intestinal obstruction,—namely, progressive distention, inability to pass gas per rectum, and the appearance of the shape and movements of the coils of intestine, which can be observed when the abdominal walls are sufficiently thin.

Tenderness in the right iliac region is an early and a marked symptom. While there may be more or less diffused tenderness in this region, it will usually be easy to indicate the site of the appendix by a correspondingly increased amount of tenderness at a particular spot. The usual location of the appendix will be found to be at the outer edge of the right rectus abdominis muscle, at varying distances below a line drawn from the centre of the umbilicus to the anterior superior spinous process of the ilium (the omphalo-spinous line). The location of this point of tenderness will vary somewhat with the location of the appendix and its relation to the external surface of the abdomen, with the length of the appendix, and with that portion of the long axis of the organ which is primarily the seat of the disease. It is manifest at a glance that an exceptionally long appendix, having its attachment to the cecum normally placed, and the latter in the usual anatomical position, may, by becoming the site of an inflammation at its tip, give rise to very acute sensitiveness upon pressure at a point remote from the right iliac fossa, and at the same time the right iliac fossa be free from tenderness altogether. With an especially early and extensive involvement of the postperitoneal connective tissue, there may be marked tenderness in the loin.

In the early stage of the disease tenderness is only elicited when pressure is made in the immediate neighborhood of the appendix itself. With the formation of adhesions about the organ the adjoining coils of small intestine, the ascending colon, the cecum and frequently more or less of the overlying omentum, become matted together and fixed about the site of the original peritoneal inflammation. As a result of this, pressure upon other portions of the abdominal surface, by disturbing the underlying parts, will sometimes cause these in their turn either to drag or to press upon the parts involved in the focal point of inflammation. Symptoms of tenderness in the right iliac region will thus be elicited, if the portion of the appendix originally involved lies in this region.

In such cases, where the inflamed portion is located remote from the usual position of the base of the appendix, this symptom, like that following direct pressure, will usually be referred to the point of focal inflammation, wherever that may be.[1]

In case of displacement of the cecum from a short mesocolon, or because of the persistence of the early fetal state, the symptom of tenderness, as well as all other symptoms, may be entirely removed from the right iliac fossa and be transferred to the umbilical region, or even beyond this to a point beneath the left rectus muscle (cases of so-called left-sided appendicitis). Three instances of the latter have already been reported by the author.[2]

The first of these was a young woman, who was suddenly attacked with colicky pains, which were thought to be due to intestinal colic. A point of tenderness existed at the outer border of the left rectus muscle, on a line with the umbilicus. Perforation took place on the third day, and the patient died. The autopsy revealed a perforated appendix, the cecum being located behind the umbilicus, the appendix pointing to the left, and an abdominal cavity filled with sero-purulent fluid and fecal matter.

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[1] To this rule, however, I have observed occasional exceptions. With the appendix located quite remote from McBurney's point, I have still found the point of maximum tenderness at the latter.

[2] See Medical News, Philadelphia, November 25, 1893, p. 604.

A second case was that of a young male, who was admitted to St. Mary's Hospital on the seventh day following a sudden attack of general abdominal pain followed by vomiting. The pain had been at no time localized. The physician in attendance had made out a tumor beneath the left rectus muscle, and, believing this to be the result of fecal impaction, cathartics had been administered. The tumor disappeared, although the bowels did not move; the pains increased in severity, and the patient became greatly prostrated. A median abdominal section was made at once. The abdominal cavity was found to be the seat of a large amount of sero-purulent fluid and fecal matter. The caput coli was found immediately behind the umbilicus, the cecum was turned to the left, and the appendix lay behind the left rectus muscle, just below the level of the umbilicus. The patient's condition did not admit of an attempt to remove the appendix, but the autopsy showed this to be gangrenous and perforated.

The third case was also that of a young male, who was seen by me in consultation with Dr. Burge upon the third day following a sudden attack of severe abdominal pain, which had been followed by nausea and vomiting. Tumor, marked tenderness and dulness on percussion existed in the left iliac region. Left lumbar sensibility was likewise marked. The temperature was 104° F., and the pulse 124. A diagnosis of left-sided appendicitis was made, and he was removed to the Methodist Episcopal Hospital for operation. A median abdominal section revealed a large sero-purulent collection free in the peritoneal cavity, and an abscess cavity in a mass of adhesions, which communicated with a second large abscess cavity in the post-peritoneal connective tissue. The patient's condition did not admit of prolonged search for the appendix, but two days afterward a post-mortem examination of the parts revealed this to be gangrenous and perforated, and imbedded in the mass of adhesions located in the middle of the left iliac fossa, which had been the site of an appendicular abscess. The ascending colon was situated to the left of the colon, and the cecum was at the level of the umbilicus.

Unless the possibility of this or some other anatomical abnormality is borne in mind, the entire train of symptoms will be misinterpreted, and the true nature of the disease present unrecognized.

In palpating the surface of the abdomen while seeking for localized tenderness, the surgeon will note a certain amount of rigidity of the right rectus abdominis muscle corresponding to the site of the primary focus of inflammation. The symptom will be pronounced in proportion to the involvement of the corresponding portion of the parietal peritoneum. For instance, it will be well marked in those cases in which extensive adhesions form anteriorly, as in the matting together of the appendix, the anterior surface of the ascending colon and cecum, and the overlying omentum. On the other hand, it may be entirely absent in the early stage of the disease, before the formation of any adhesions, or late in the disease, when the adhesions which form are placed posteriorly to the appendix. Furthermore, absence of this symptom is not to be accepted as evidence against the existence of appendicitis, for in those cases in which the appendix passes into the pelvis, or is directed posteriorly and passes directly upward behind the cecum, that portion of the parietal peritoneum corresponding to the rectus muscle may not become involved in the inflammation until late in the disease. Finally, the occurrence of an encysted sero-fibrinous or fibrino-suppurative peritonitis, following upon an appendicitis in which the abdominal wall forms a portion of the environment of the collection of fluid, will cause rigidity of the overlying muscular structure. General peritoneal inflammation will cause tension of all of the muscular structures of the abdomen.

As the disease advances, tympanites from paretic distention of the adjacent coils of intestine takes place. Stokes has called attention to the disturbances of function of portions of the intestinal tube that border upon structures which are the site of progressive inflammatory processes. With the spread of the peritoneal inflammation the coils of the intestine in the vicinity become more and more distended, and new ones become involved in the paretic condition. The effect of this will be to cause a prominence of the right as compared to the left iliac fossa, although this symptom may also result from the presence of an abscess cavity or an encysted sero-fibrinous or fibrino-suppurative exudation.

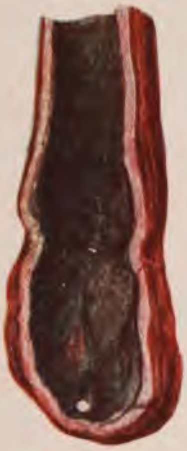
It is somewhat rare for the tumor itself, which is made up of the appendix and a mass of adhesions, to produce a marked prominence in the right iliac fossa, unless suppuration has taken place. This may occur, however, in very thin subjects.

Other symptoms present themselves, according to the position of the appendix and the part involved in the inflammation. More or less irritability of the bladder from peri- or para-cystitis occurs in those cases in which a long appendix passes into the pelvis and lies adjacent to the bladder at the time of the attack. Among these somewhat rarely observed symptoms are also to be mentioned retraction of the thigh, or partial flexion of the latter upon the trunk. This symptom is sometimes, although not invariably, observed in those cases in which the inflamed appendix rests upon the posterior layer of the parietal peritoneum, corresponding to the flexor muscles of the thigh. The retro-peritoneal connective tissue, and finally the sheath of the muscle, may, under these circumstances, become involved by extension through the iliac fascia which separates the peritoneum from the muscles. The latter become disturbed functionally through interference with their nerve supply, and as a result their points of insertion are approximated and the symptom under discussion is produced.

The occurrence of a chill during the first stage of the disease is only occasionally noted, even in cases of more than usual severity. In certain cases it marks the occurrence of suppuration. Neither the severity of the primary attacks nor the gravity of the subsequent lesions seems to bear more than a casual relation to the occurrence or pronounced character of this symptom.

The temperature and pulse vary in different cases, although they do not by any means bear a constant relation to the gravity of the attack. Generally speaking, an early and considerable elevation of temperature and rapid pulse rate accompany a high degree of inflammation, with tendency to early perforation or gan-

PLATE VIII.



Acute appendicitis with gangrene of mucous membrane and perforation.

grene; but the reverse does not hold true. I have known perforation to occur before the formation of protecting walls of adhesions, with a pulse of 80 and a temperature of 99° F.

During the first stage of a case which is to follow the average course there will be an elevation of temperature of from one to three degrees Fahrenheit. This moderate elevation of temperature is apt to be misleading to the medical attendant. Failure to recognize the exact degree of inflammation of the appendix itself during the early stage of the affection would be of but very little moment were it not for the possibilities of perforation occurring prior to the formation of adhesions and consequent septic peritonitis; or the dangers of septic infection of a profuse sero-fibrinous exudate (suppurative peritonitis) without perforation, as well as the infection following the lymphatic vessels of the peritoneal investment of the appendix and thence to the general peritoneum.

A remission of all the symptoms of the first, second and third stages, save local tenderness, may take place, and yet the disease pass steadily onward through all its stages to a fatal termination. *A lowering temperature and lessening pulse-rate are not inconsistent with impending ulceration, perforation of the appendix into an unprotected peritoneal cavity, complete gangrene of the organ, or rupture of an appendicular abscess into the cavity of the peritoneum.*

The occurrence of diffuse septic peritonitis will be announced by increased abdominal pain (unless this symptom be masked by the administration of opium), increasing distention and progressive prostration. The pulse and temperature likewise indicate the occurrence of this condition; the former by gradually increasing rapidity and a correspondingly lessened force, and the latter by a gradual but decided elevation; this rise is frequently followed by a fall which may reach a sub-normal point. The features become pinched and drawn and the eyes sunken. The surface of the body, particularly the extremities, becomes a bluish color, cold, and often bathed in a most profuse perspiration. Vomiting, which may have been present previously and copious, becomes scanty. The patient maintains a position upon his back, with the knees drawn up. The muscles of the abdomen are tense, and the latter is either flattened or prominently rounded from distention. The respirations are short and rapid; hiccough is sometimes present at the very last. Albuminuria, with the presence of indican, are marked features; total suppression of the renal secretion may occur. The constipation is intractable.

If the intra-peritoneal sero-purulent fluid is more or less encysted, the symptoms will be less urgent. From time to time there will occur acute attacks of pain, fever and vomiting, while the symptoms present a series of alternating exacerbations and remissions. The exacerbations under these circumstances are due to an occasional extension of the area of inflammation involved in the original focus, and perhaps an increase in the quantity of the encysted fluid which forces back the adhesions and gives rise to new plastic exudation. The temperature does not become sub-normal, but, on the contrary, may be higher than in the diffuse suppurative form. The facies abdominalis is less marked, and the pulse is less rapid and feeble. The skin maintains its normal heat and color. The perspiration is less profuse, and may be absent altogether. There may be vomiting from time to time. The renal secretion is not suppressed, although, perhaps, scanty. Neither albumen nor indican are present as a rule.

A marked difference in the different forms of the affection will be found in the appearance of the abdomen. In the rapidly diffused septic form it seems as if the entire intestinal tube was completely paralyzed at the very outset, and that absolutely no intestinal gas finds its way into the canal. As a result of this, a flattened appearance of the belly follows. On the other hand, in the encysted variety only those portions of the intestinal canal that come within the influence of the inflammatory area are disturbed in their functions, and then not to the same extent as in the fulminant form. These portions, in consequence, will become distended by gas forced into them from the still functionally active portions of the canal, and progressive tympanites will become a more prominent feature of this variety. The abdomen will become more and more rounded, and finally barrel-shaped. The latter features will also mark the slowly progressive form of diffuse septic peritonitis. (For a further account of peritonitis as a complication, see chapter xii.)

The contents of an appendicular abscess may find their way into an adjoining coil of small intestine, thus forming a communication between the cavity of the intestine and that of the appendix itself (pathological anastomosis). In a case of chronic relapsing appendicitis seen by me in consultation with my colleague, Dr. L. S. Pilcher, at the Methodist Episcopal Hospital, this condition was revealed at the operation. In addition, the appendix was found to be the seat of a stenosis shutting off the distal third of the cavity of the organ, which had been originally the site of a cystic dilatation (empyema of the appendix), and perforation. An interchange of contents between the cavity of that portion of the ileum which lay immediately adjoining the appendix and that of the latter, as well as the abscess cavity itself, thus took place, leading to a reinfection of the latter and an occasional relapse of the symptoms.

Spontaneous extra-peritoneal evacuation of the abscess occurs in a certain proportion of cases. The evacuation takes place comparatively seldom in the direction of the anterior abdominal walls. It may take place posteriorly, the purulent infiltration thence finding its way along the psoas muscle to the thigh ; or it may follow the line of the vessels over the pelvic brim and appear at the crural opening.

Again, evacuation may take place into the rectum, in which case, like its analogue—the abscess of tubal origin (pyosalpinx)—the fecal communication may give rise to constant reinfection and refilling of the abscess cavity. Finally, the bladder, and in the female the vagina, may serve as an outlet for the purulent collection.

CHAPTER IV.

SPECIAL TYPES OF APPENDICITIS.

Special types or varieties of the disease are sometimes observed, differing from the affection as already described. Even in these cases, almost without exception, there can be obtained a history of the first, second and sometimes of the third stage of an average acute attack. From this point, however, the symptoms seem to veer off, as it were, from the typical course, only to return to it after a greater or lesser length of time.

The forms now to be considered are the subacute, the chronic, the relapsing and the recurrent varieties.

Subacute Appendicitis.—The *subacute* variety is not to be looked upon as an innocent form of the disease. Although the febrile action is slight, and the pain and tenderness such as occasion no alarm, these insidious symptoms may be replaced, without warning, by those indicating the occurrence of perforation and diffuse septic peritonitis; or the latter condition, as already stated in discussing the acute variety, may come on without perforation.

Imprisoned fecal matter, more or less inspissated, is sometimes found to occupy the cavity of the organ in these cases. The fecal matter in a soft state probably enters the lumen of the appendix through a narrow appendiculo-cecal orifice. In its more solid form its subsequent exit is interfered with by the existence of the narrowing alluded to. Its continued presence within the appendix is a constant menace to the individual. Again, the conditions giving rise to symptoms of this form may have their origin in pathological changes in the vessels and nerves of the meso-appendix. In this class of cases the symptoms are indicative of a subacute condition from the beginning.

The subacute form may supervene upon the acute variety. Convalescence may follow this remission of the symptoms, but the change from an acute to a subacute form is only too often more apparent than real, and leads to a sense of fancied security on the part of the physician and patient, to be followed by the occurrence of one or more of the grave accidents which only too frequently mark the further progress of the disease. This was strikingly exemplified in the case of Gambetta, the celebrated French statesman.

Chronic Relapsing Appendicitis.—Where the affection stops short at the first stage, or perhaps even recedes more or less from this to a stationary but persistent condition of subacute endo-appendicitis, it is said to have assumed a chronic phase of the disease. The mucous membrane, the submucous connective tissue, and, in some cases at least, the walls of the appendix, persist in a condition of subacute inflammation, from which one or more relapses may occur in the course of a few weeks. The patient may become seemingly convalescent, in that pain and all febrile symptoms disappear. He may even be permitted to resume his avocation. Within a few weeks, or even earlier, a relapse takes place, with symptoms perhaps more violent and threatening than at first. The violence of these relapses may be attributed to the lowered vital resistance incident to vascular and nervous lesions in the walls of the appendix itself, as well as in its mesentery. There is one symptom, at least, which does not entirely disappear, and its presence should always place the attendant upon his guard against this form of the affection. I allude to the symptom of persistent tenderness. This is sometimes accompanied by the presence of a tumor, although the latter is not an essential symptom of this type of the disease.

In this class of cases the symptoms may likewise indicate a subacute or chronic condition from the first.

Recurrent Appendicitis.—This form of the disease is not rare. A certain proportion of cases occurring in adults will give a history of previous attacks, one or even more in each year. These cases are to be distinguished from the chronic relapsing form, and it has therefore seemed best to assign them to a special class. The special feature of the form under consideration is the fact that the attacks occur at either short or long intervals, suggesting some predisposing cause which continues active after recovery from the first attack. It differs from the relapsing form of the disease in that entire recovery apparently takes place. The patient remains free from any clinically discoverable trace of the affection for varying periods, when suddenly and without warning he is subjected to another exacerbation of the symptoms. The differences between the relapsing and the recurrent forms of the disease are analogous to the differences existing between an attack of typhoid fever in which a relapse and a second exacerbation supervenes during the convalescence, and an attack of malarial fever in which complete recovery appears to take place, but in which some predisposing condition existing in the patient, conjoined with some exciting cause incident to his surroundings, leads to a recurrence of the disease.

The length of time over which these recurrent attacks may extend is surprising, as well as the remarkably large number which may occur within a short time, and yet recovery take place.

The following are presented as illustrative of this class of cases :

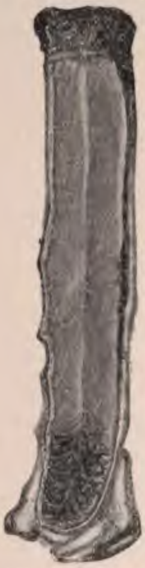
J. N., aged forty-five, was seen by me in consultation with Dr. Weygandt, of this city, during an acute attack of appendicitis. He declared that he had suffered during the past eight years from attacks of colicky pain, referred to the general abdominal region, occurring at intervals varying from one to three months, and that he must have had more than fifty such attacks. An operation performed January 12, 1893, revealed an appendix which was thickened, strictured, dilated beyond the stricture, ulcerated and perforated at the dilated portion, angulated at the proximal portion of the organ, and gangrenous between the angulated portion and the base. The appendix was removed.

The patient made a good recovery, and when last seen, nearly a year after the operation, he stated that he had remained in perfect health ever since that time.

Dr. H. W. C. came under my care with the following history : Two years before, while travelling in California, he was attacked during the night by appendicitis. He had eaten a hearty meal before retiring. After a week he convalesced. During the succeeding two years he suffered from thirteen separate and distinct attacks. These were sometimes preceded by diarrhœa, and sometimes by constipation. On October 27, 1891, the appendix was removed after the subsidence of an attack. It was found to be the seat of a chronic thickening, its cavity being obliterated, and its structure changed to that of a fibrous cord.

Cases likewise occur in which the minimum amount of damage is inflicted upon the organ, in spite of the fact that a number of indubitable attacks have been suffered from. The following is a case in point:

PLATE IX.



Appendix showing minimum amount of damage inflicted after several attacks, the last being two weeks before the operation.

A male patient, age thirty-one, was admitted to the Brooklyn Hospital on January 27, 1898, with a history of having suffered from several attacks of appendicitis during the past three years, the last having occurred two weeks previously. Operation in period of quiescence. The appendix appeared to be normal, but upon making a longitudinal section the distal portion was found to be decidedly thickened, with elevation of the folds of mucous membrane at this point (Plate IX).

A striking variation in the local vital resistance of the appendix in different individuals is shown by comparing the appearances as presented in the plate representing the specimen from the case just related with those exhibited in Plate XII, in which perforation in the primary attack took place within twenty-four hours of the first symptoms.

CHAPTER V.

COMPLICATIONS OF APPENDICITIS.

Peritonitis.

The most important complication of appendicitis is the occurrence of peritonitis in one or another of its forms. Inflammation of the serous investment of the appendix itself is not included in the present consideration, nor should the occurrence of this form of localized peritonitis, which leads to the formation of adhesions, be considered as other than salutary. Diffused inflammatory affections of the peritoneum resulting from infection are, however, among the most frequent, as well as the most fatal, complications.

For convenience of study the occurrence of diffuse peritonitis as a complication of appendicitis may be divided into the following:

(1) Perforative Peritonitis.
(2) Infectious Peritonitis.
(3) Tubercular Peritonitis.

Perforative Peritonitis.—In this variety the infection takes place from the intestinal canal. By far the greatest number of cases of diffused peritonitis complicating appendicitis have their origin in this manner. The lesion of the appendix giving rise to the peritonitis may involve necrosis of its walls, as in ulcerative lesions, more or less complete destruction of the organ, as in gangrenous lesions, or the infectious micro-organisms may pass through the wall of the appendix without actual loss of substance of the latter when this is the seat of circulatory disturbances with resulting nutritive changes and the establishment of a *locus minoris resistentiæ.*

The germ most frequently found is the *bacillus coli communis.* The almost constant presence of this germ may not be due so much to the fact that it is alone the cause of the peritonitis, but because it is the most common and abundant infectious agent in this locality under normal conditions, constituting, as it does, about 75 per cent. of all the germs found in the intestinal canal. Further, it has been shown that this micro-organism possesses such rapid powers of reproduction that other microbes are crowded out of existence by its growth, or at all events their identification is rendered difficult or impossible.

Infectious Peritonitis.—In this variety of peritonitis as it occurs in appendicitis the inflammation of the peritoneum is caused by extension of infection from a pre-existing focus of infection about the appendix, such, for instance, as an appendicular abscess. It is the variety present following imperfect asepsis in operative procedures involving exposure and contamination of peritoneal surfaces, under circumstances of a previously aseptic abdominal cavity (post-operative peritonitis).

In infectious peritonitis the common pus-organisms—viz., the staphylococci and streptococci—are present. In the more severe and rapidly progressive cases the streptococcus is most frequently found, and for the reason that this, so far as at present known, is the most virulent of the pus-organisms, the peritonitis due to this cause is quite as fatal as that due to the colon bacillus. The staphylococci are also frequently found; usually, however, in conjunction with other organisms.

Tubercular Peritonitis—Occasionally cases are presented with the symptoms of either acute or chronic appendicitis, which upon abdominal section reveal the presence of tubercular peritonitis as a complication. The variety of tubercular peritonitis most frequently found is the fibrous form of Aldibert. These cases are not usually accompanied by ascites. Larger tubercles are found here and there upon the peritoneal surfaces, and the coils of intestine are matted together by adhesions. The involvement of the appendix in tubercular peritonitis is usually, like the latter, a subacute or chronic process. In cases in which an acute process supervenes this is due to the occurrence of ulceration of tubercular foci in the peritoneum covering the appendix with resulting tissue necrosis. The natural low vital resistance of the appendix vermiformis as a vestigial organ renders it more liable to destructive changes in tubercular infection than other portions of the intestine. The symptoms of acute appendicitis may be the first to attract attention to the abdominal cavity, or the patient may have complained for several months of symptoms pointing to chronic appendicitis.

Symptoms and Course of Perforative and Infectious Peritonitis.

Onset.—The onset will depend upon the virulence of the infecting agent and the method and site of invasion of the peritoneum. The rapid dissemination of infectious material over a large serous surface, as in perforation of the appendix, before the occurrence of adhesions, into an unprotected peritoneal cavity, or in infectious peritonitis from the rupture of an abscess into the cavity of the peritoneum, particularly if this take place in the intestinal or diaphragmatic areas, will give rise to proportional symptoms of shock, rapidly followed by collapse. Inflammations, the result of slow extension from a septic focus in or about the appendix are not attended by shock.

Pain.—This is an early symptom, and varies, both in its severity and persistency, with the virulence of the infection and the rapidity of the extravasation. It is rarely absent altogether, although it may not be sufficiently prominent, in some cases, to cause complaint. Tenderness develops *pari passu* with the progress of the infection, being at first localized, subsequently becoming general. Its intensity varies with the grade of inflammation present, as a rule.

Nausea and Vomiting.—Nausea and vomiting are almost invariably present and follow rapidly upon the onset of the disease in severe cases. The stomach contents are at first vomited, this being soon followed by bile, and finally, in fatal cases, by material from the small intestine. The vomited matter may be of a dark-brown color; this is due to hemorrhage from the mucous membrane.

Paralysis of Peristalsis.—This occurs early, as a rule, in extensive and virulent infections, and is soon followed by symptoms of obstruction. With the occurrence of the latter there is generally an absence of the gurgling sounds of peristalsis. Distention, which in slowly infectious processes is sometimes the first symptom, may at first be moderate, and limited to the coils of intestine in the immediate neighborhood of the original site of the infection, thence extending gradually; in rapid and grave cases it soon becomes general and excessive, the skin of the abdominal wall becoming tense, livid and shining; the resonance everywhere is tympanitic.

Rigidity of the abdominal walls may be localized at first; afterward it becomes marked and general, but with increasing and excessive distention it may become modified, or disappear altogether.

Constitutional Symptoms.—Symptoms of septic absorption set in early in unfavorable cases. There is a rapid rise in the pulse-rate from 120 to 160; exceptionally it may be less than 100 to the minute. The temperature is subject to great variations, more or less elevation being the rule, however. It may be excessively high or but slightly affected; occasionally, and at the very last, it is below the normal. The intellect may remain unaffected to the end. The countenance becomes drawn and anxious, constituting an almost pathognomonic sign of the disease. The livid surface and blue finger-nails mark the onset of vaso-motor paralysis. In mild cases with slow development of the disease there may be but moderate disturbances of pulse and temperature. Chills are seldom complained of. (For treatment of peritonitis see page 137.)

Spontaneous Evacuation of Appendicular Abscesses.

Into the Peritoneal Cavity.—With evacuation of the contents of an abscess cavity about the appendix, or of an intra-peritoneal sero-purulent collection into the peritoneal cavity, the characteristic symptoms of general or diffuse peritonitis soon manifest themselves. There is an accelerated pulse-rate, abdominal pain, intestinal paresis followed by tympanitic distention, and anxious countenance.

Through the Intestinal Canal.—If the evacuation of the pus be by the intestinal canal a diarrhœa supervenes. This may consist of only a few loose discharges; there are evidences of the presence of pus in the stools.

Into the Bladder.—If the contents of the abscess escape by the bladder, pus will appear in the urine. There will be symptoms of cystitis present. In severe cases there may be dysuria, frequency of micturition, and even vesical tenesmus.

Evacuation into both Intestine and Bladder.—This double route is occasionally selected for the evacuation of the pus. It is announced by the appearance of fecal matter in the urine. This may be in sufficiently solid masses to block the urethro-vesical orifice and lead to retention. Retained fecal matter within the bladder will serve as a nucleus for the formation of a vesical calculus. The contraction of the abscess cavity will result in the establishment of a direct communication between the intestine and urinary bladder, which will become permanent.

Into the Vagina.—This is by far the most favorable route that could be selected by nature for the spontaneous evacuation of the pus. The opening is usually direct and either in the posterior *cul-de-sac* or the right lateral fornix ; exceptionally it may find it way into the left lateral vaginal fornix.

Into the Thigh.—The escaping pus from an appendicular abscess may follow the iliac vessels over the pelvic brim into the right thigh and simulate a psoas abscess in its final pointing.

Into the Post-Peritoneal Connective Tissue.—An invasion of the post-peritoneal connective tissue will result in deep-seated infection and sometimes extensive burrowing of pus into the structures of the lumbar and dorsal regions. In two cases of this kind, occurring in my hospital service, one died from purulent infection of the lumbar and dorsal regions, and prolonged septic conditions. The autopsy revealed a small post-cecal abscess cavity, in the wall of which the thickened and infiltrated appendix lay. In the other case, upon incising the abscess wall a large amount of pus, which had been walled in, escaped. Upon introducing the finger a communication was found to exist between this and a similar smaller cavity lying behind the cecum.

There is a growing belief among surgeons that the dorso-lumbar abscesses of former times which could not be ascribed to a lesion of the osseous spinal column, and which were sometimes called peri-nephritic abscesses for want of proper knowledge regarding their origin, were really cases of suppurative inflammation of the retro-peritoneal connective tissue, having their origin in an appendicular abscess, in instances in which the appendix lay entirely or in part behind the peritoneum. Even a history of an acute attack of appendicitis may be absent in these cases, and yet the infection have its origin in the appendix.

Into the Anterior Abdominal Wall.—This will lead to the occurrence of abscess in the wall of the abdomen. The latter usually points in the neighborhood of the umbilicus. Several cases of this kind have come under my observation, the histories of which dated back several weeks and involved the usual and typical symptoms of appendicitis.

Through the Diaphragm and Bronchus.—The collection of pus may make its way through the diaphragm and perforate the base of the lung after the formation of pleural adhesions, finally escaping through a bronchus. In at least one instance with which the author is familiar the occurrence of this accident was followed by the sudden death of the patient. He was literally drowned by the rapid flow of pus.

Complications arising through the Medium of the Portal Circulation.

When the freedom with which the mesenteric veins feed the portal circulation is taken into account, the ease with which septic emboli from thrombo-phlebitis of these radicals may be carried to the liver, and there give rise to hepatic abscess, will be readily understood. As a matter of fact, however, mesenteric thrombophlebitis is only an occasional complication of appendicitis. Reginald Fitz calls attention to the possibility of its occurrence, and suggests that it may be due either to a direct extension of the primary phlebitis or to septic embolism.[1] Three cases of hepatic abscess of appendicular origin, in which pleuritis and pericarditis followed an eruption of the abscess cavity through the diaphragm, are reported by Gendron.[2]

This, as well as other late complications and sequelæ of the disease, will become less and less frequent as the dangerous character of the disease becomes more generally recognized, and early operative procedures are instituted for its relief.

Hepatic Abscess.—As a result of pylephlebitis, hepatic abscess, either single or multiple, may occur. This is a most serious complication, and may so mask the other symptoms as to completely mislead the attendant as to the true nature of the case. The thrombi within the mesenteric veins become displaced, either in their entirety, or by portions becoming loosened and swept by the current of blood into the portal vein, through which channel they reach the liver in the shape of sepsis-bearing emboli. The mechanism is the same as in hepatic abscess following dysenteric affections, and certain operative procedures upon the hemorrhoidal veins.

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[1] American Jour. Med. Sciences, October, 1886, page 330.

[2] Étude sur le pylephlebite suppurative, Thésis de Paris, 1885.

The symptoms of hepatic abscess following appendicitis are such as accompany suppurative foci within the liver substance due to other causes. Digestive disturbances, irregular chills, pain referred to the right hypochondriac region, erratic variations of temperature, tenderness just beneath the lower border of the ribs upon the right side, in some instances an icteric hue of the conjunctiva and skin—these are the symptoms which change almost entirely the aspect of the case, and render the symptomatology puzzling to the medical attendant, unless he is mindful of the possibility of the occurrence of this complication.

Purulent Pleuritis and Purulent Pericarditis.—These may result from the hepatic abscess. A large collection of pus, situated superiorly or posteriorly within the liver, will tend to find its way through the diaphragm. The latter will first be pushed upward, and give rise to difficulty of breathing. Later on the diaphragm itself will become inflamed, giving rise to considerable pain, and, finally, ulceration and perforation will permit the pus to find its way into the pleural cavity, or into the cavity of the pericardium. If it is not removed from this situation by operation, and the patient survive sufficiently long, the purulent collection may ultimately be discharged externally either by means of a spontaneous opening between the ribs, or through the bronchi. Especial attention has been called to suppurative pleuritis as being a relatively frequent complication of appendicitis by Terrillon.[1]

Iliac Phlebitis.—This may occur as a complication of appendicitis. The condition will prove a very obstinate one with which to deal. It is due to an infection, either from appendicular abscess, or a suppurative parietal appendicitis. In these cases the appendix lies in the direction E or SE (Fig. 9). Phlebitis of both sides may occur simultaneously, due to an infection of both veins by a long appendix stretching across on the W line; or the vein on the left side may become involved subsequently to that of the right.

Phlebitis with thrombosis of the iliac vein may give rise to edema of the corresponding lower extremity. If septic changes occur in the thrombus, and portions of the clot become loosened and displaced, pulmonary thrombosis and septic pneumonia may be among the sequelæ of appendicitis. The following case is offered for illustration:

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[1] Discussion upon Quénu's paper, "Operative Treatment of Recurrent Appendicitis in the Intervals of the Attack." Bull. et Mém. de la Soc. de Chirurgie de Paris, Vol. XVIII, p. 397.

J. K., aged eighteen, was admitted to my service, at St. Mary's Hospital, upon the recommendation of Dr. Pearson, suffering from the usual symptoms of acute appendicitis, of three days' duration. Seven years before (1886) he had suffered from a similar attack, which eventuated in an iliac abscess. This was "lanced," as he expressed it. A scar, three-eighths of an inch long, marked the site of the former operation.

At the time of his admission iliac phlebitis and septic pneumonia were present.

An incision parallel with Poupart's ligament was employed. The peritoneum was found to be crowded away from the lateral pelvic wall. The peritoneum was not divided, but was pushed in a direction inward and upward. Upon exploring the space between the peritoneum and the lateral pelvic wall I came upon an abscess cavity containing about three ounces of pus. After the pus was evacuated the space was found to be bounded posteriorly by the iliac fascia. The appendix lay in the SE position, entirely extra-peritoneally, and rested directly upon the iliac vessels. It was removed.

The right-sided septic pneumonia, in progress before the operation, followed the usual erratic course of this disease, and recurring chills and exacerbations of fever occurred, coincident with fresh involvement of lung tissue. Final recovery ensued.

The Occurrence of Appendicitis in a Hernial Sac.—This should be noted as among the complications occasionally met with. It may occur in connection with either inguinal or femoral hernia. The contents of the hernial sac may consist of the cecum together with the appendix, or of the latter alone. In a case which came under my observation at the Methodist Episcopal Hospital about one-half of the appendix with its mesentery had escaped through a very small crural ring, where it became strangulated, giving rise to symptoms of inflamed femoral hernia. A history of appendicitis, or of hernia preceding the attack, could not be obtained.

In this class of cases the existence of a tender tumor at one of the usual sites of hernia upon the right side, together with general abdominal pain, and perhaps vomiting, will, in the majority of cases, lead to a diagnosis of either inflamed or strangulated hernia. The possibility of the existence of appendicitis in a hernial sac should emphasize the rule of never attempting the reduction by taxis of an inflamed and tender hernial protrusion.

Appendicitis occurring during Pregnancy—The occurrence of appendicitis during pregnancy constitutes a most important complication in which the responsibility of the medical attendant in making an early diagnosis is greatly increased, since two lives are at stake. In my experience the complication of diffuse septic peritonitis in this class of cases has been uniformly fatal, in spite of any operative effort; both mother and child have been invariably lost under these circumstances. On the other hand, cases diagnosed early and in which appropriate treatment has been instituted may be expected to recover and have normal deliveries. Pinard calls attention to the spastic muscular contraction of the abdominal muscles of the right side (*défense musculaire*) as a characteristic initial symptom of appendicitis in pregnant women.[1]

Appendicitis occurring during the Puerperal State.—Attention is called to this complication for the purpose of placing the practitioner upon his guard, and warning against the error of attributing every untoward abdominal and pelvic symptom occurring during the first few days following delivery to septic inflammatory conditions of the uterus or adnexa. Although there is no direct relation to be traced between the delivery and the occurrence of appendicitis during the puerperal state, the prognosis here, as in other cases of inflammation of this organ, is largely dependent upon early diagnosis and prompt operative interference. Two cases of this kind have been sent into my hospital service by Dr. Frank E. Wilson, of this city, both of which occurred on the tenth day following delivery. An uncomplicated recovery may be expected to follow an early and carefully conducted operation, the puerperal state serving in no wise to contra-indicate operative interference.

Appendicitis complicated by Intestinal Obstruction.—The occurrence of peritonitis, more or less localized, in the course of appendicitis sometimes leads to the formation of vicious adhesions between adjacent coils of intestine, or between these and the appendix. The form of obstruction is most frequently an angulation. The occurrence of ballooning above the obstruction from paralysis of peristalsis of the coils of intestine involved in the peritoneal inflammation in the neighborhood of a septic focus favors the occurrence of the final and complete obstruction. In addition to obstruction by angulation cases occur in which the appendix partially encircles a coil of small intestine and becomes adherent by its tip, the appendix, in these cases, acting as a constricting band. The latter occurs most readily when the appendix occupies the position shown at C, Fig. 10.

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[1] Ann. de gynécol., 1899, March.

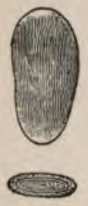
CHAPTER VI.

THE ETIOLOGY OF APPENDICITIS.

The etiology of inflammatory suppurative conditions in the neighborhood of the right iliac fossa was supposed in former times to involve the presence within the appendix vermiformis of cherry-stones, grape-seeds, lemon- and orange-pits, date-stones, fish-bones, pins, etc. This idea was so firmly fixed in both lay and professional minds that children were carefully watched while eating fruit to prevent them from swallowing a stone or seed, which, it was believed, would lodge in this "death trap," as it was popularly called, and produce what was at that time considered an almost necessarily fatal malady.

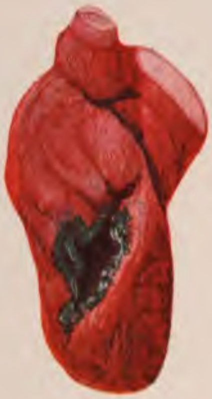
The belief that the disease is frequently due to the passage of foreign bodies into the cavity of the organ is based, to a large extent, upon purely speculative or imaginary conditions or erroneous observations. In an exceptionally large experience in the operative treatment of this disease, in but three instances was any body found other than soft fecal masses, which could be construed as being in any sense "foreign." Two of these were true enteroliths, made up of calcareous salts, arranged in concentric layers (Fig. 11); the other was a gall-stone.

FIG. 11.



In all probability the notion that cherry-stones, lemon- and orange-pits or date-stones are largely responsible for the occurrence of the disease is based upon the fact that little masses of fecal matter, which have been moulded into shapes accurately representing these bodies, are found during the evacuation of an appendicular abscess. It has happened more than once during an operation of this character at my hospital clinic that one or another of the bystanders has exclaimed, as the little mass of fecal matter came into view, "A lemon pit!" or "A date-stone!" so strong a resemblance is there between these masses and the bodies mentioned. In every instance, however, the fact that they were, with the above-mentioned exceptions, made up of moulded fecal matter was

PLATE X.



Appendicitis with gangrenous perforation.

demonstrated by simply flattening them out between the thumb and finger.[1]

Beyond the little masses of fecal matter which become imprisoned in the cavity of the appendix by the occurrence of constriction, either at the point of communication with the cecum or at some other portion of the tube, nothing in the shape of a foreign body, other than those above-mentioned, has been found in my experience to account for the conditions present. The ease with which fecal matter may maintain its position in the cavity of the appendix may be easily understood when two facts in the anatomy of the organ are borne in mind. These are, first, the fact that it normally occupies a dependent position in the large majority of cases; hence, gravity alone will aid the passage of fecal matter into its interior, and also favor its retention there. Second, the absence of well-marked circular muscular fibres gives rise necessarily to a very feeble expulsive power. Hence, it may be said that the appendix vermiformis does not have that inherent power of emptying itself which other hollow organs, supplied with longitudinal and circular involuntary muscular fibres, combined in proper proportions, possess. In addition, anatomical studies and clinical experience (examinations made of healthy appendices during laparotomies) unite to support the assertion that fecal matter is found in the appendix in a considerable number of individuals who had never suffered from the symptoms of appendicitis. The mere presence of masses of fecal matter, therefore, cannot be looked upon as necessarily producing the disease, save when these become more or less hardened by inspissation. This hardening process takes place after their imprisonment, and is due to absorption of the watery elements after the escape of the fecal matter itself is cut off. In this condition they may, by their presence, produce in an already partially devitalized organ ulcerative changes, or even extensive gangrene, by still further interfering with the normal circulation. That the disastrous perforation which is so frequently a marked feature of the disease is not necessarily due in all cases to the presence of inspissated fecal matter is shown by the fact that they are not always present when this accident occurs. When they are present they are not always found at the point of ulceration. Moreover, cases are observed in which the entire outer structure of the appendix has sloughed away as a result of a violent inflammatory process, leaving the mucous membrane as an intact blind sac with fecal matter in its interior. The following case, occurring in my hospital service, will illustrate this condition:

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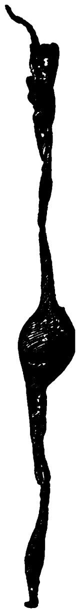
[1] The possibility of the production of the disease by foreign bodies is not denied; the statement is simply made here that, as a clinical fact, in my experience, it is of rare occurrence. (See chapter xv.)

FIG. 12.



(×⅔). The intact mucous lining of an appendix, the outer walls having sloughed away, showing a coprolith in position. (From a photograph.)

H. T., aged eighteen, male, was admitted to the Methodist Episcopal Hospital with the history of having been attacked seven days previously with the usual symptoms of appendicitis. General peritonitis was present and the patient's condition was very unpromising. The usual right-sided laparotomy revealed the remains of the appendix in the shape of a worm-like tube, consisting exclusively of the mucous lining of the organ. This was not perforated, although at a point midway between its tip and the place of its attachment to the large intestine its lumen was occupied by a rather hard fecal concretion (Fig. 12). The walls of the organ had sloughed completely away. The cavity of the peritoneum contained a large amount of sero-purulent material.

How much the presence of fecal matter, independent of its mechanical effects, may influence the origin of the inflammation is yet to be determined. The fact that fecal matter of itself does not necessarily give rise to the disease is, to my mind, sufficiently proven.

In all probability it will be found that the inflammation has its origin in noxious agents (micro-organisms) which are conveyed to the interior of the organ in the fecal matter when the latter is present. Although these agents are usually present in fecal matter, they may find their way into the tube without the aid of the latter.

As predisposing causes to the disease may be mentioned actinomyces and tubercular and typhoid ulcers. The influence of fecal concretions has already been referred to. Actinomycotic appendicitis has been observed by Ransom[1] and by Otto Lanz.[1] The occurrence of occlusions of the lumen, either partial or complete, are likewise predisposing factors. These occlusions may be the result of former inflammatory changes, but are more frequently the result of retrograde evolution which this organ seems to be gradually undergoing.

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[1] Proceedings of the Royal Med. Chir. Soc., London, 1891–2, S. IV, 14.

The invasion of the mucous membrane, and of the submucous layer of connective tissue as well, by micro-organisms which are possibly harmless so far as the mucous membrane of the colon is concerned, but are disease-producing in the mucous membrane of the appendix, at all events, will account for all of the phenomena of the disease. The normal epithelial lining of an organ, useless in the animal economy, and which is probably undergoing evolutionary changes tending toward its final disappearance, may be found by the histologist to have already been subjected to changes which distinguish it from that lining the cecum, and which may have robbed it of its function as a barrier to bacterial infection. Among these evolutionary changes a progressively lowered vital resistance would naturally be the first departure, so far as the tissues are concerned, and this alone would favor violent inflammatory alterations, though the same etiological factors would not be sufficient to produce these effects in the colon or ileo-cecal region. The possibilities of a previously existing meso-appendicitis should not be overlooked in this connection. It has been suggested that the difference in the lumen of the cecum and appendix may account, to some extent, for the immunity of the cecum and the susceptibility of the appendix. It is easier to produce abrasions in a small tube than in a large one, and the mucosa once deprived of its epithelium easily becomes infected by micro-organisms.

The conclusion is, therefore, irresistible that infection following the establishment of the *locus minoris resistantiæ* is not only the principal, but is the necessary cause of acute appendicitis. Some infectious material enters the appendix, and there becomes fixed as a result of the very inefficient expulsive power of the organ. The secretions of the appendix furnish excellent soil for the development of the micro-organisms. The degree of virulence of these organisms will govern the violence of the inflammatory catarrhal attack if other conditions, such as the existence of stenosis of the canal, or the presence of concretions, are favorable. The ease with which the disease may become chronic following an acute attack is due to the fact that the tissues of the organ are being continuously fed by constantly proliferating infectious material and its toxic products. With any increase of virulence there occurs a renewed or an acute attack, this being favored by the lowered vital resistance of the organ. Whatever fecal matter, either fluid or solid, chances to be present plays but an accidental role. It is not even necessary that these fecal masses should produce either ulceration or even perceptible abrasion of the mucous membrane. As a matter of fact, their physical qualities are usually such as render it altogether probable that they produce no primary lesion, but that in their soft condition they may remain for an indefinite period of time within the tube without doing harm. That fecal masses do occur within the cavity of the appendix vermiformis without the occurrence of inflammatory processes is proven by the frequency with which their presence is noted in post-mortem examinations, as well as in laparotomies performed for other conditions.

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[1] Korrespondenzblatt für Schweizer Aerzte, 1892, No. 19.

The relation of the blood supply to the occurrence of the disease has led to a critical study and review of the conditions which govern this supply. These studies have been principally directed to the presence or absence of a mesentery connected with the organ. So far as I have been able to judge, from examinations made of appendices removed in a diseased condition, the disease occurs quite as often in those individuals in whom a well-formed and vascular meso-appendix is present as in those in whom the mesenteric attachment is but slightly developed or altogether absent.

The study of the clinical anatomy has not, to my knowledge, been heretofore undertaken. The shape and relative position of the appendix as found in individual cases may favor the development of the disease. Thus, an angulated or exaggerated curve-shaped appendix may favor circulatory disturbances, and a directly vertical position with the tip downward the passage through the orifice of fecal matter. The absence of anything like uniformity in its relation and direction under conditions of both health and disease,[1]

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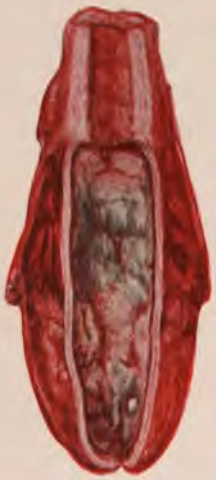
[1] See Annals of Surgery, May, 1894, p. 562.

PLATE XI.



Acute appendicitis. Stenosis of appendix following former attack.

however, makes it improbable that the above-mentioned conditions are etiological factors except in a predisposing manner. While, therefore, these will explain the occurrence of certain symptoms in some cases which are absent in others, they cannot be looked upon as essentially etiological factors in the disease.

The condition of the bowels prior to the attack has been the subject of considerable study in connection with the disease. The only conclusion which can be drawn is that neither preceding constipation nor diarrhea occurs in a sufficiently large number of cases to stand in a causative relation to the disease; and that a normal condition of a daily movement of the bowels is observed in the majority of cases.

The influence of age upon the occurrence of the disease is of importance. The affection is not confined, by any means, to the age of childhood, as was formerly supposed; yet its somewhat greater relative frequency in early life has led to the opinion that age is one of the predisposing causes. It is rare at the two extremes of life. The comparative frequency, in my experience, of the disease at the different periods of life, agrees essentially with the observations of Bamberger, Paulier and Maurin, as given by Talamon, and of Reginald Fitz, to whom the profession is greatly indebted for a large number of accurate observations upon the disease.

The following table shows the age and sex of the cases of appendicitis admitted to the surgical wards of the Methodist Episcopal Hospital, Borough of Brooklyn, New York City, during the past ten years:

TABLE OF SEX AND AGE OF 340 CASES.

Age.	Males.	Females.	Total.
Under ten years	12	0	12
Ten to twenty years	68	32	100
Twenty to thirty years	71	39	110
Thirty to forty years	53	10	63
Forty to fifty years	25	10	35
Over fifty years	15	5	20
Grand total	244	96	340

Those at the extremes of life are comparatively free from the disease. The youngest case of acute appendicitis in my experience was three years of age. The oldest patient was sixty-nine, and was a male. Another male was sixty-five, and a female was sixty-three. Age did not seem to handicap these patients ; they all made uncomplicated recoveries.

The influence of sex upon the occurrence of the disease has been studied by Bamberger (1864), Volz, Marchăl, Paulier (1875), Fitz (1886 and 1888), and Maurin (1891). Taking the total number of cases of these observers, and combining them, the following result is obtained :

Total number of cases observed	543
Total number occurring in males	430
Total number occurring in females	113
Percentage occurring in males	80
Percentage occurring in females	20

In my own experience, about the same proportion of males to females was observed.

Traumatism is scarcely to be considered as a cause of appendicitis, although in one of my own cases the patient gave a history of a blow over the region of the appendix just before the onset of the attack. The next nearest approach to injury is the case of a patient who attributed the attack to a strain he had received the day before in lifting a heavy block of ice from a wagon. Another instance is that of an athlete in whom the disease developed during the night after he had engaged in a game of foot-ball. In none of these cases does it seem to me that the blow, violent effort or exercise bore any causative relation to the attack of appendicitis.

Indigestion has also been regarded as one of the determining causes of the attack. This belief has probably arisen from the frequency with which vomiting and pain, referable to the epigastrium, are prominent symptoms of the first stage of the attack. These symptoms, as has already been insisted upon, are not due to digestive disturbances, as a rule, but are purely reflex phenomena. It rarely happens that undigested food is vomited, and the movements of the bowels following upon an attack of appendicitis do not show evidences of irritating ingesta. It is common enough to have patients declare that they must have eaten something which disagreed with them, but so far as my experience goes I have failed to trace an etiological relation to such a cause even by careful questioning, save in but a single instance (*vide infra*). Talamon, however, believes that the erratic peristalsis produced by the presence of irritating material within the digestive tract determines the engagement of a stercoral calculus in the orifice of the appendix. This in its turn gives rise, according to this observer, to the symptoms here described as constituting the first stage of the disease. I cannot subscribe to this belief.

In the rare instances in which the digestive disturbance seems to precede the development of the disease, the connection between the two occurrences may still be dependent upon bacterial agency. It has been shown by experiments upon animals that cultures of the intestinal micro-organisms derived from patients, the subjects of diarrheal diseases, possess far more virulent toxic properties than those taken from healthy individuals.[1] Whether the catarrhal inflammatory conditions present in these diseases, and which, to a greater or lesser extent, are present in those attacks commonly regarded as the result of indigestion, and the increased virulence is due to the irritating ingesta which produce the indigestion, or whether, in the life-history of the bacterium, the virulence occurs as a part of the biological change which it undergoes, this, in its turn, acting as the irritating or infectious agent, has not as yet been determined. If the former, it may readily be supposed that an attack of indigestion, by producing certain changes in the intestinal tract and converting the theretofore harmless micro-organism into one of greater or lesser virulence, would stand in a causative relation to the disease. In this connection the following case is of interest:

M. B., aged forty-seven, with no history of a previous attack, and of previous regular habit of bowels, dined at a cheap restaurant, which was not at all his habit, making a hearty meal of pork and cabbage. He was attacked the same evening (December 15, 1889) by pains, referred to the epigastrium, and with vomiting. Pain in the right iliac region developed four hours later and tenderness in the latter region was present upon the following day. The vomited material consisted of the partially digested food of the above-mentioned meal.

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[1] Macaigne, Le Bacterium Coli Commune, Paris, 1892.

I saw him on the fifth day, at which time a tumor was present. An incision made into the latter evacuated about five ounces of sero-purulent material from a cavity formed by adhesions about the inflamed appendix. The latter lay in the NE position, and was evidently a portion of the limiting wall of the abscess cavity in that direction. For this reason the organ was not removed.

The patient made a good recovery, but on November 19, 1892, nearly three years later, he dined, under the same circumstances, at the same restaurant, and partook of the same character of meal. The same evening he was attacked with pains and vomiting; the pain finally centred in the right iliac fossa. The vomited material showed partially digested pork and cabbage. Within thirty-six hours of the commencement of this attack primary perforation and septic peritonitis had taken place, shortly after which I saw him and operated. The appendix was removed and it was found to have been the seat of a rapidly suppurative process; extreme dilatation had taken place and rupture of its contents into the general peritoneal cavity followed. The patient was a diabetic, with low powers of vital resistance. It is interesting to note that the appendix, at the second operation, lay in the SE position.

In spite of the fact that the terms "typhlitis" and "perityphlitis" have been virtually abandoned, for the reason that, whatever the origin of the inflammation, the involvement of the appendix contributes most largely to the dangerous character of the affection, it is still thought by careful observers that the disease not infrequently has its starting-point in a catarrhal inflammation of that portion of the cecum corresponding to the point of communication between the latter and the appendix. Kümmell[1] still insists that the chronic relapsing form of appendicitis has its origin in inflammatory catarrhal processes within the cavity of the cecum, being propagated thence by continuity of tissue to the interior of the appendix. The secretion of the latter continues to empty into the colon until the point of communication is closed by swelling near the orifice, or by stenosis elsewhere. This view is also held by Iverson, and is supported by the frequency with which strictures of the vermiform process are observed in the relapsing form of the disease. In this variety, too, perforation is the exception, and not the rule. While a mild inflammatory process at this part of the cecum may pass away without the occurrence of symptoms sufficient to call attention to its presence, the occurrence of even a slight catarrhal inflammation of the appendix leads to constriction of the tube, the retention of secretion and to the formation of coproliths.

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[1] Archiv. für klinische Chirurgie, Vol. LIII, 3 and 4.

To sum up, therefore, the disease is due: first, to the low vital resistance of an organ of a peculiarly vestigial character, and second, to infection from the presence of one or more of the intestinal micro-organisms. Circulatory disturbances more or less readily produced by sharply curved or angular shapes of the organ, or a deficient or interrupted blood supply as well as the presence of accidentally imprisoned fecal matter, which is prevented from returning to the cecum both because of the feeble expulsive power of the tube, due to an insufficiency or entire absence of circular muscular fibres, and on account of constriction of the tube which may or may not be due to previously existing inflammation, still further increase the possibilities of infection. This fecal matter, because of bacterial infection which it conveys to the parts, or from the pressure effects due to inspissation, or both, contributes to the etiology of the disease in its entirety, but particularly in the cases in which perforation takes place. Bacterial infection, however, may occur independently of the presence of fecal matter, and the presence of fecal concretions or foreign bodies is not at all essential to ulceration, perforation or gangrene.

For an account of the changes resulting from disturbances of nutrition involving either vascular or nervous lesions, or both, which, by lowering the vital resistance of the tissues of the appendix, prepare the way for bacterial infection, the reader is referred to the chapter on the Inflammatory Lesions of the Vermiform Appendix.

CHAPTER VII.

BACTERIOLOGICAL CONSIDERATIONS.

The question of the relation existing between the bacteria of the intestinal canal and the etiology of appendicitis has recently awakened an unusual interest among both bacteriologists and surgeons, owing to a more careful study of these micro-organisms. From the time when the digestive tube becomes the receptacle of food and its products, these bacteria are found in greater or lesser variety.

Attention has been particularly called to the ordinary and common form of bacillus which is found in the discharges from the intestinal canal so constantly that the latter has come to be looked upon as its natural habitat. This organism, known as the *bacillus coli communis* (Escherich), it would appear, bears a more or less definite relation not only to inflammatory conditions within the abdominal and pelvic cavities, but likewise to these conditions when occurring under certain circumstances remote from the intestinal tract. For instance, it may, according to a number of observers, pass the barrier of the intestinal mucosa, although under favorable conditions it is claimed that it may even give rise to active desquamative lesions here, and penetrate into the general circulation; thus, reaching parts remote from its original and apparently normal location, in which it seems to play an innocent role, it has been claimed to give rise to suppurative conditions of the most decided character.

While the fact of its discovery in pure culture, in cases of enlarged spleen (Wyss), in a hematoma following thyroidectomy (Tavel), in diseases of the biliary passages (Gilbert, Girode, Naunyn), in abscess of the liver (Rodet, Veillon, Jayle, Stern, and A. Fränkel), in lymphangitis of the arm (Levy), in septic emphysema (Chiari), in general pyemic infection, with suppurative meningitis (Stern), and in broncho-pneumonia, endocarditis, meningitis, nephritis, and cystitis (Henkemaus), is of interest, yet its presence in connection with these conditions does not possess an importance in our present study beyond the fact that it serves to establish its migratory character. Its presence in connection with suppurative peritonitis (Larulle, Roux, Rodet and A. Fränkel) and in peritonitis consecutive to an intestinal lesion without perforation (Welch), and in cases of appendicitis, both acute, perforative and chronic relapsing (Ekehorn, Roswell Park, Hodenpyl), together with my own heretofore published observations upon this subject,[1] seem, at first glance, to establish a direct and specific etiological relation between the *bacillus coli communis* and inflammatory diseases of the appendix vermiformis.

In addition to demonstrating the existence of this micro-organism in the exudate of the accompanying peritonitis of appendicitis, it has been shown (Hodenpyl) that the cavity of the appendix in new-born children, as well as the healthy peritoneal cavity in general, is sterile. Again, in so far as experimental bacteriology can establish the fact, the *bacillus coli communis* has been demonstrated to be pathogenic to rabbits and guinea-pigs, when bouillon cultures made from isolated colonies, obtained from appendicitis cases, are injected into the abdominal cavities of these animals (Ekehorn, Hodenpyl, Wilson). The suggestion of Ekehorn,[2] however, that, in comparatively mild forms of the disease (recurrent and relapsing cases), the virulency of the bacillus is not so great as shown by its effects upon the lower animals following inoculation, as compared with cultures derived from acute and rapidly-progressive instances of the disease, is not borne out by experiments made for me by Dr. Wilson at the Hoagland Laboratory.

The fact that the *bacillus coli communis* can be obtained in pure culture from the peritoneal surface of an inflamed appendix which has not undergone perforation, as well as from the walls of the organ, the interior of its mucous canal, from the contents of an appendicular abscess, and both isolated and non-encysted intra-peritoneal collections of fluid which have undergone changes the result of septic influences, is now well established. It has, likewise, been conclusively shown (Hodenpyl) that this micro-organism exists under normal conditions in the cavity of the vermiform appendix.

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[1] The New York Medical Journal, Vol. LVIII, October 14, 1893, page 434.

[2] Bacterium Coli Commune, en orsak till Appendicit, Upsala Läkere. Förh., 1892–3, XVIII, 113–150.

In one of my cases of appendicitis a pure culture of the *bacillus coli communis* was obtained from a layer of plastic lymph which glued the inflamed appendix to the cecum. The mucous membrane of the organ was not involved in the inflammation, and, although the walls of the organ were involved in an exudative inflammatory process, a large number of sections made by Professor Van Cott failed to reveal the presence of the micro-organism. It will probably be found that decided disturbances of the relations of the intestinal canal, such, for instance, as the fixing of the colon in an abdominal wound for the purpose of an artificial anus, will lead to the migration of the intestinal micro-organisms.

The assumption, however, that the *bacillus coli communis* is the sole infecting agent of appendicitis and perforative peritonitis is unwarranted, as shown by Barbacci, of Florence.[1] This observer examined 14 cases of perforative peritonitis in man, and made a number of experiments upon animals. Of the 14 cases, 1 was an aspirated so-called perityphlitic abscess; 7 were typhoid perforations; 2 were perforating ulcers of the stomach; 1 of perforation of the vermiform appendix; 1 of perforation from strangulated hernia; 1 of perforating ulcer of the cecum; and 1 of gangrene and perforation following volvulus. Bacteriological examinations were made under favorable conditions,—*i. e.*, immediate autopsies in cold weather, to exclude putrefactive organisms.

Barbacci reaches the following conclusions:

> (1) In perforative peritonitis in man, cultures from the exudate yield only one organism in the vast majority of cases,—the *bacillus coli communis*. In but a single case of the fourteen was another micro-organism, the *micrococcus lanceolatus* (Fränkel), associated with the *bacillus coli communis*. (2) Inoculations into the peritoneal cavity of susceptible animals (white mice and guinea-pigs) with fresh exudate of peritonitis produce peritonitis, and in eight cases out of the thirteen the *micrococcus lanceolatus* was found. (3) The *micrococcus lanceolatus* is present in about 60 per cent. of all cases, but is overlooked because it is overgrown by the *bacillus coli communis*. (4) Experiments on dogs by opening the abdomen, securing a loop of intestine, and causing a perforation by the application of caustic potash produced a peritonitis exactly simulating, both microscop-

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[1] Ueber Aetiologie und pathogenese der Peritonitis durch Perforation. Centralblatt f. Allgemeine Pathologie u. Pathologische Anatomie, October, 1893.

ically and bacteriologically, a perforative peritonitis in man. The animals died in from twenty to thirty hours, and examinations after death show a general fibrinous peritonitis. Enteritis was not found in any of the cases. Pure cultures of the *bacillus coli communis* were obtained from the exudate. (5) Marked differences exist as to the result when, upon the one hand, the examination is made directly from the exudate, or by the culture method, on the other. Cultures show only *bacillus coli communis,* but by direct examination a number of different organisms may be found, the latter dying in the exudate in the early stages of the inflammation, the *bacillus coli communis* growing alone in the cultures. In dogs killed at intervals of 5, 5½, 6, 8 and 10 hours after perforation, examination showed the *bacillus coli communis* mixed with other organisms up to eight hours; after this the former alone was found. The *micrococcus lanceolatus* was not found in the experimental peritonitis in dogs.

Dr. Ezra H. Wilson, pathologist to St. Mary's Hospital, director of the Department of Bacteriology of the Hoagland Laboratory, and chief of the Bacteriological Bureau of the Brooklyn Board of Health, at my request made bacteriological examinations in the following cases of appendicitis occurring in my hospital services. The operations for the removal of the appendix were conducted aseptically,—*i.e.,* only heat-sterilized instruments, etc., were employed; no antiseptic agents were employed in the case until after the removal of the organ. In each case the latter was ligated at two points, and the section for its removal made between two heat-sterilized ligatures. The appendix was then placed in a sterilized glass tube, which was immediately sealed and forwarded to the laboratory for examination. In two cases (Nos. 7 and 8) smear preparations for direct examinations and direct cultures were also made.

The technique of the examinations was as follows: The cultures were made in peptone bouillon from the mucous membrane through sterilized incisions in the wall of the appendix. Cultures were also made from the outside of the appendix, and also from the exudate of the peritoneal cavity in some cases, at the time of the operation. Smear preparations were made directly from the exudate; these were stained and examined immediately.

Bouillon cultures were incubated for twenty-four hours and then plated. From the isolated colonies of the plated preparations other bouillon cultures were made, which were used for experiments upon animals.

The media employed were beef-peptone bouillon and gelatin.

Case I.—November 7, 1893. Male, twenty-seven. No previous attacks. Was attacked suddenly with acute abdominal pain. Tumor developed rapidly, and was distinctly felt at the end of twenty-nine hours. Operation thirty-two hours after commencement of symptoms. Appendix surrounded by a mass of adhesions, and the seat of a cystic dilatation. No other adhesions. Appendix amputated between two ligatures and placed in a sterilized glass tube for examination. Recovery.

Bacteriological Examination.—Appendix surrounded by considerable new tissue and fibrin. Two cavities were present, separated by a constriction.

The lower cavity contained pus. Cultures were made from both cavities and from the outside of the appendix, and carried along parallel. The cultures from both developed pure *bacillus coli communis.* From 1 to 2 c.c. of bouillon cultures derived from isolated colonies were injected into the peritoneal cavities of guinea-pigs. The animals died in from twenty-four to forty-eight hours, and the organism was recovered in pure culture from the peritoneal cavity. It was not found in or recovered from the blood or organs. The peritoneal infection was very slight; the animals apparently died from general sepsis.

Case II.—November 25, 1893. Male, fourteen. No previous attack. Suddenly attacked with usual symptoms; local tenderness developed within two hours. Fever pronounced from the commencement. No tumor. Operation on second day of disease. Appendix divided between two ligatures and removed. No perforation. Placed in sterilized tube as in Case I.

Bacteriological Examination.—Same technique as in Case I. Result: Pure cultures of *bacillus coli communis* obtained in all of the cultures. Pathogenic to guinea-pigs.

Case III.—November 26, 1893. Male, twenty-eight. Two previous attacks; the first two years, and the second one year, ago. Present attack sudden in onset, with general abdominal pain. Temperature ranged from 101° to 102° F. No tumor. Great prostration and anxious facial expression from the second day. Admitted to hospital on the fifth day, and operated upon at once. Sero-purulent fluid in the peritoneal cavity. Appendix removed and cared for as in other cases. Appendix gangrenous, perforated in two places. Three small fecal masses present. Patient died of profound septic intoxication and pre-existing peritonitis in thirty-six hours.

Bacteriological Examination.—Technique same as Cases I and II. In the Petri dish, colonies of a different nature were found. These proved to be the *bacillus pyogenes fetidus.* The colonies of *bacillus coli communis* were scanty, while those of the *bacillus pyogenes fetidus* were very abundant.

The *bacillus coli communis* was pathogenic for guinea-pigs, causing death in forty-eight hours. The death resulted from peritonitis and toxemia combined.

The *bacillus pyogenes fetidus* proved to be exceedingly virulent. It was pathogenic for guinea-pigs when used in the same manner as the *bacillus coli communis*, causing death of the animal in twelve hours.

Bouillon cultures derived from isolated colonies of the *bacillus pyogenes fetidus* were filtered through sterilized Chamberland filters, and proved to be sterile by culture. Two cubic centimeters of this sterilized culture were injected into the abdominal cavity of guinea-pigs with a negative result. The animals recovered in each instance.

Case IV.—November 28, 1893. Male, twenty-two. Chronic relapsing appendicitis operated upon one week following a relapse. First attack five months previously; has suffered one attack each month on an average since. No tumor. Appendix thickened, surrounded by adhesions, and hanging from its implantation in the cecum in the shape of an inverted interrogation-point.

Bacteriological Examination.—Cultures made from the outside of the appendix and from adhesions. Both developed pure *bacillus coli communis.* Bouillon cultures twenty-four hours old made from isolated colonies were injected into the peritoneal cavity of guinea-pigs. These caused death in thirty hours. The organism was recovered pure from the peritoneal exudate, but not from the blood or organs.

Case V.—December 7, 1893. Male, ten. Chronic relapsing appendicitis operated upon one month following the fourth relapse. Patient also the subject of acromegaly. No tumor. Typical amputation of the appendix, which was four and a half inches long, corkscrew-shaped, placed in the directly downward (S) position, and notably thickened.

Bacteriological Examination.—Cultures from the appendix and its cavity developed pure *bacillus coli communis.* Pathogenesis not tested.

Case VI.—December 11, 1893. Male, twenty-four. One previous attack eight years ago, which led to the formation of abscess. This was incised. No attempt was made to remove the appendix at that time. Present attack sudden in its onset, and accompanied by the usual symptoms of an average severe attack. Chill occurred on the third day. Pneumonia developed and present at the time of the operation. Tumor present. Lumbar tenderness. Operation between the fourth and fifth day. Appendix found to be entirely extraperitoneal. Removed. The patient made a good recovery in spite of the presence of pneumonia at the time of the operation.

Bacteriological Examination.—A mixed growth developed, consisting of a micrococcus and a bacillus. The latter was rather larger than the *bacillus coli communis*, and stained very slowly. The micrococcus was somewhat larger than the *staphylococcus pyogenes aureus*, and stained readily. Placed in Petri dishes and isolated, the micrococcus proved to be the *micrococcus flavus liquefaciens*, and was evidently a contamination. The bacillus proved to be *bacillus coli communis*

Case VII.—December 15, 1893. Male, twenty-three. Four previous attacks at intervals of about a year. Present attack came on gradually for first twenty-four hours. It then suddenly developed into an acute condition, following which septic symptoms and great prostration rapidly supervened. Abdominal cavity, upon being opened, revealed some clear fluid. Some of this was obtained in sterilized Sternberg bulbs. A large sero-purulent collection surrounded the appendix. Smear preparations were made on clean slides directly from the exudate. Cultures upon agar plates were also made directly from the exudate. Appendix removed and placed in a sterilized glass tube. Patient died in thirty-six hours from profound sepsis.

Bacteriological Examination.—The smear preparations show a variety of organisms. Small diplococci resembling the *diplococcus lanceolatus*, small and large bacilli, some of which resembled *bacillus coli communis*, and a streptococcus resembling the *streptococcus pyogenes* were present. Single colonies from one agar plate, at room temperature for twenty-four hours, showed pure *bacillus coli communis*. The other agar plate, placed for the same length of time at incubating temperature, showed likewise only *bacillus coli communis*. The serum drawn from the peritoneal cavity in the Sternberg bulbs before opening the encysted sero-purulent collection was found to be sterile.

CASE VIII.—December 20, 1893. Male, twenty-one. No previous attacks. Present attack developed suddenly, with usual symptoms of an average severe case. Fever present from the commencement. Appendix found surrounded by adhesions and considerable sero-purulent fluid. Cavity of peritoneum well walled off. Smear preparations made directly from the exudate, and some of the exudate obtained directly with sterilized Sternberg bulbs. Appendix removed; ulcerated and perforated. Placed in sterilized glass tube. Recovery.

Bacteriological Examination.—Cultures made from the exudate on slanting agar, and from the exterior and interior of the organ all developed pure *bacillus coli communis*. The smear preparations show the same variety of organisms as the preceding case,—*i.e.*, a diplococcus, the *diplococcus lanceolatus*, a bacillus, the *bacillus coli communis*, and a streptococcus, probably the *streptococcus pyogenes*.

CASE IX.—December 25, 1893. Male, seventeen. Chronic relapsing appendicitis operated upon in an acute relapse. Present attack came on ten days previous to admission to the hospital. Fever present since that time. Tumor present. Appendix found embedded in a mass of inflammatory adhesions. Appendix removed.

Bacteriological Examination.—Cultures made as before. Result, pure *bacillus coli communis*.

CASE X.—December 25, 1893. Female, twenty-one. No previous attack. Present attack sudden and accompanied by usual symptoms. Fever from commencement of the attack. Appendix infiltrated. No adhesions. No perforation. Recovery.

Bacteriological Examination.—Pure cultures of *bacillus coli communis* obtained from walls and interior of appendix.

As a result of these investigations, Dr. Wilson reached the following conclusions:

(1) The *bacillus coli communis* exists constantly in the lumen of the appendix and also in the exudate in the peritonitis accompanying inflammations of that organ. This can be demonstrated both by direct examination and by cultures.

(2) Other bacteria than the *bacillus coli communis* exist constantly in the exudate, and can be demonstrated by direct examination, but very rarely by culture.

(3) That perforative peritonitis from appendicitis is not a mono- but a poly-infection, and that, while the *bacillus coli com-*

munis probably has the largest share in the infection, the presence of other organisms cannot be ignored.

It must therefore be apparent that attempts to establish the existence of a specific bacterium as the cause of appendicitis must almost necessarily fail in the present state of bacteriological science, from the fact that the infection may be a simple or a mixed one. Several varieties of organisms find their way into the exudate at once, and even where but one of these is identified, it is more than likely, from the fact that ample opportunity is afforded for the entrance of a variety of bacteria from the intestinal canal, that others are also present, and are either subsequently destroyed by the more rapidly growing organisms, or remain unidentified. The failure of identification may arise either from an absence of definite differentiating characteristics, or proper culture media. There can be no question, however, that the real cause of the rapidly destructive processes which mark the progress of the disease is due to microbic infection.

The disturbances of local tissue nutrition and consequent lessened vital resistance which invite bacterial invasion are described in the chapter on the Inflammatory Lesions of the Vermiform Appendix.

CHAPTER VIII.

THE DIAGNOSIS OF APPENDICITIS.

The diagnosis of acute appendicitis is to be based upon the following symptoms: First, the suddenness of the attack; second, the occurrence of acute abdominal pain; third, tenderness at the site of the appendix; fourth, the occurrence of nausea and vomiting, either accompanying or following the pain.

The location of the pain is of special diagnostic value. In the great majority of cases it is at first referred to the region of the umbilicus and to the epigastrium. In the course of a few hours, however, it becomes centred in the right iliac region, although more or less abdominal pain may still be complained of. The pain, as already mentioned, is acute in the sense that it is sufficiently severe to transcend the powers of endurance of an average individual, and to demand measures of relief at the hands of the medical attendant.[1] The severity of the pain, the suddenness of the onset, the fact that it is referred to the epigastrium, or thereabouts—in addition to these, the occurrence of nausea and vomiting, may distract the attention of the physician from the appendix vermiformis altogether. Prior to the present decade the diagnosis of acute indigestion or of a "bilious attack" was made in a large majority of these cases.

The character of the vomited material will vary with the ingesta. The stage of digestion reached, as shown by the vomited material, will correspond very closely with the time which has elapsed since the last meal was taken. In other words, the vomiting is not that of indigestion.

The patient assumes the dorsal decubitus almost without exception. Inspection, even at the very commencement of the disease, will frequently reveal, during the respiratory act, some limitation of movement on the part of the abdominal muscles, particularly upon the right side. This feature, however, may not be marked if opium has been freely administered. If it be permitted to manifest itself, it will become more and more marked as the disease progresses. Because of this limitation of movement on the part of the abdominal muscles concerned in the act of respiration, thoracic respiration becomes a feature of the attacks to a greater or less extent. With the patient narcotized with opium, the entire absence of this symptom is not to be relied upon as evidence against the existence of the disease.

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[1] With the appendix extra-peritoneally located, the pain at first may be dull in character. Peritoneal involvement gives rise to acute and lancinating pain.—(J. D. Bryant.)

In more advanced stages of the disease, adhesions having taken place, together with some inflammatory exudation, fulness opposite the anterior superior spine of the ilium, and beneath the right rectus muscle, will be observed. This may also be apparent along the line of Poupart's ligament, particularly in thin subjects. In cases in which the inflamed appendix lies upon the flexor muscles of the thigh as they pass along the posterior limits of the iliac fossa, the right thigh, or even both thighs, may be flexed. That this symptom does not possess the diagnostic value formerly attributed to it, however, is shown by the fact that in two instances coming under my observation, in which the post-peritoneal connective tissue was the seat of a large purulent collection, this symptom was entirely absent. In both cases the appendix was extra-peritoneally situated.

The patient's facial expression is not usually indicative of a serious abdominal lesion in the first stage of the disease, but with the advance of the latter the characteristic anxious look of peritoneal inflammation develops (facies abdominalis; facies Hippocratica).

Progressive abdominal distention, as the peritonitis becomes less and less localized, develops with the advance of the disease, and intestinal paresis becomes more and more marked. As a consequence the abdomen becomes rounded, and sometimes even barrel-shaped, significant of diffuse septic peritonitis.

Abdominal distention may be due to the constipating effects of opium, or to an accumulation of gas, without the occurrence of peritonitis. This will give rise to much discomfort, but other symptoms of diffuse peritonitis will be absent. Richardson, of Boston,[1] advises auscultation of the abdomen in differentiating between the two conditions. Where the distention is due to paralysis of peristalsis due to peritonitis and sepsis, no sounds whatever will be heard on auscultation. On the other hand, where the distention is due to the less grave condition, there is no inhibition of peristalsis, and evidences of intestinal action will be obtained.

Palpation shows tenderness in the right iliac region and a sensation of tension or even rigidity is imparted to the palpating hand in certain cases by contact with the muscular walls of the abdomen, particularly the right rectus muscle. Pronounced tenderness in the right iliac region, which is almost invariably present unless masked by the administration of opium or some other equally powerful narcotic, is almost as pathognomonic of appendicitis as rusty sputum is of pneumonia. Involuntary muscular tension is not equally marked in all cases in the beginning of the disease. The presence or absence of this symptom seems to bear some relation to the proximity of the inflamed appendix to the anterior abdominal wall and to the extent to which the patient has been narcotized by opium in the treatment.

The sensitiveness will be slight or well marked, according to the stage of the disease and the severity of the attack. This is the feature of the disease which forms the best diagnostic guide, and indicates more than all the other symptoms combined the progressive character of the attack. Its increase from day to day, and sometimes even from hour to hour, denotes increase in the gravity of the case. On the other hand, marked and rapid lessening of the tenderness both in intensity and in area (providing always that this symptom is not being masked in the particular case by the narcotic effects of opium), indicates, other things being equal, a subsidence of the inflammatory action.

The tenderness may be present over an area as large as the palm of the hand, even in the first few hours of the attack, but as a rule it is limited at this time to a point near the centre of the right iliac fossa. Here its presence will be determined by pressure with the points of the fingers.

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[1] The American Journal of the Medical Sciences, January, 1894, p. 7.

Providing the case is seen sufficiently early to permit with safety of the necessary manipulation, the following method of examination will be found to give the most satisfactory results:

The tips of the fingers should be laid flatwise upon the abdominal wall and steady pressure made directly backward until the smooth regular surface of the iliac fossa is felt. The finger-tips are moved about, the abdominal wall moving with them, and the fossa thus explored. Pressure made in this manner may be repeated until the entire right half of the abdomen has been systematically examined. Tenderness at several points may be elicited.

Exceptionally, by this method of examination, it is possible to identify the appendix in the interval between the attacks in cases of the chronic relapsing form of the disease. I have succeeded in thus identifying it, both in the class of cases above mentioned, and also in instances where abdominal section was about to be performed for conditions other than those relating to lesions of the appendix, and in which the latter was in a normal condition. When the abdominal muscles offer a very decided resistance to the palpating finger-tips, this may be overcome by grasping this hand by the other, or disengaged hand, thereby reinforcing the former. Considerable pressure may thus be made in this class of cases without that sacrifice of delicacy of touch which is apt to occur if one hand is relied upon both for forcible pressure and palpation. In persons with relaxed abdominal walls the iliac arteries and the appendix vermiformis may be made out with more or less distinctness. In persons with thick or rigid abdominal walls the identification of the appendix cannot be made without the aid of an anesthetic, and even under these circumstances it becomes, to a great extent, a mere matter of guess-work.

As the disease advances another point of special tenderness develops parallel with Poupart's ligament, and just opposite and below the anterior superior spinous process of the ilium. This is due to adhesions which form between the dextral surface of the caput coli and cecum and the lateral pelvic wall. When pressure is made in this region there is greater dragging upon the parts adherent at this point than elsewhere, owing to the rigidity of the pelvic wall. Distinct tenderness nearer the median line, about the umbilicus or in the supra-pubic region denotes a corresponding position of the inflamed appendix. Tenderness limited to a very small spot may sometimes be elicited by placing the finger-tip firmly against the abdominal wall and bidding the patient cough.

Treves has laid stress upon palpation through the rectum. I have been able in this manner to demonstrate a greater degree of tenderness upon the right than upon the left side. The "sausage-shaped" tumor described by Treves I have seldom been able to make out. Generally speaking, it is not possible to demonstrate by means of a rectal examination in these cases anything which cannot be made out much more satisfactorily by external examination; if the examining surgeon is to be the operator in the case, he will do well to keep his finger out of the rectum.

Examination per vaginam when the disease attacks the female is thought to be of value by Lennander.[1] If the inflamed appendix lies upon the "S" or "SE" line, and extends into the pelvis, the tumor may be felt from the cavity of the vagina. It will be exceedingly difficult in these cases, however, to differentiate by this method of examination between appendicitis and right-sided salpingitis or pyosalpinx; in fact, nearly all of the inflammatory lesions of the adnexa involve pain, tenderness and tumefaction. The appendix may even be involved in tubo-ovarian lesions.[2] Under these circumstances a differential diagnosis without exploratory laparotomy may be impossible.

Sensitiveness may be marked in locations remote from the right iliac fossa, due to an unusually long appendix in which the inflammatory process is most marked at the tip, or to an abnormally-placed cecum. In addition to those cases in which non-descent of the cecum is present (the latter maintaining the position in which it lies in early intra-uterine life, namely, in the neighborhood of the umbilicus), this portion of the intestinal canal may be located in the right hypochondrium behind the liver. When this happens the tenderness may be most marked at varying distances above the transverse line "W-E."

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[1] Upsala Lakareforen, Forhandl., Vol. XXVIII, part I; Centralblatt für Chirurgie, No. 16, 1893.

[2] Richelot, Bulletin de la Société de Chirurgie, October, 1890.

The following case, referred to me by Dr. F. E. Wilson, and operated upon at St. Mary's Hospital, illustrates this somewhat rare condition:

M. C. F., aged fifteen, developed the usual symptoms of appendicitis. There was marked tenderness at the site of the gall-bladder. She was seen by me on the third day of the disease and sent at once to the hospital for operation. Upon opening the abdomen and exploring its cavity the cecum could not be found in the right iliac fossa, but the transverse colon was found to descend to the level of the pubes, a portion of it occupying the usual site of the ascending colon. An attempt to follow the colon at first resulted in tracing it to the splenic flexure. I then examined it in the opposite direction, and succeeded in finding the cecum immediately behind the liver. The liver was held out of the way by an assistant, and the appendix cleared from its surrounding adhesions and removed.

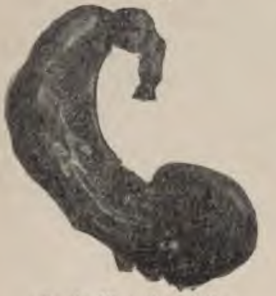
The presence of a tumor may be made out by palpation, provided the disease has advanced sufficiently far to make this symptom available, or the rigidity of the right rectus muscle is not so great as to mask its outline. There should be but little liability to mistake in the male when the tumor has once been made out and due weight has been given to the history; in the female it is different. Here the condition may so closely resemble a right-sided pyosalpinx that the most skilful diagnostician may be at fault, particularly in those cases in which a long appendix passes down into the pelvis. Fluctuation is rarely made out.

Exceptionally a tumor may be felt at an early period of the case, especially in patients with more than usually thin abdominal walls, and in whom the symptom of rigidity of the right rectus muscle is absent.

A case illustrative of this was admitted to my service at the Methodist Episcopal Hospital, on October 6, 1893.

A tumor was distinctly made out by the attending physicians, Drs. Mains and Sturges, on the afternoon of the day following the attack, twenty-nine hours after the first symptoms. The tumor was located directly behind the internal abdominal ring, was very tender to the touch, and appeared from external palpation to be the size of a small hen's egg. It was somewhat freely movable. Its localization was greatly facilitated by the entire absence of rigidity of the right rectus abdominis muscle. A right lateral laparotomy (oblique incision) revealed an appendix in the "S" position, the seat of a cystic dilatation at its proximal end. The dilated portion was about the size of a small walnut (Fig. 13). There was complete absence of adhesions, except the attachment of a portion of omentum to the inner side of the appendix.

Fig. 13.



Cystic dilatation of the appendix.

Lumbar tenderness may be more or less marked according as the peritoneum be involved in this locality, or as the inflammation extends into the post-peritoneal connective tissue. Under ordinary circumstances the symptom of lumbar tenderness is not of great diagnostic value, except as a means of assisting in establishing the probable location of the appendix before operation.

Percussion will give a note, high-pitched, dull or even flat, when extensive and dense adhesions have formed, or when suppuration has occurred in these adhesions as a result of an infection from the appendix. This percussion note becomes more marked with the advance of the disease, and as the adjoining coils of the intestine give a note which is tympanitic by comparison. In cases in which an extensive and diffused serous effusion into the peritoneal cavity occurs, dulness may be found on percussion over the latero-dorsal portions of the abdomen.

In percussing the region of the colon and cecum the fact should be borne in mind that impacted fecal matter in this locality may simulate a tumor due to appendicitis. Tenderness may also be present and due to impacted feces.

Exploratory puncture is to be mentioned only to be condemned. Its employment adds a new element of danger to the case, while its results are untrustworthy, and calculated to lead the surgeon into error, particularly if these are negative.

The occurrence of fever is of some diagnostic importance in determining the presence of the disease when taken in conjunction with the other symptoms; but, unfortunately, when not of a high degree it cannot be relied upon as an indication of the character or extent of the inflammatory process. A slight rise of temperature is not incompatible with early and fatal perforation. Again, this, together with the subjective phenomena, may disappear almost entirely, and yet the life of the patient be in the greatest jeopardy. Cases which do not pass beyond the first stage, and are of a very mild type, may be afebrile, yet even these will bear watching very closely.

Differences in temperature between that of the mouth on the one hand, and of the rectum and the vagina on the other, should always be taken into account in cases of suspected appendicitis. A difference in favor of the latter localities of more than a degree and a half may be regarded as diagnostic (Madelung), although the absence of this symptom is not to be regarded as significant.

The occurrence of a chill is of such slight importance during the first stage of the disease as not to merit particular notice in this connection. Even in the subsequent stages when suppuration is in progress it cannot be regarded as a frequent nor as an important symptom. The clinical fact that intra-peritoneal suppuration does not give rise to chills or chilly sensations, much less to a rigor, as frequently as do suppurative processes elsewhere, may here be noted.

In the average typical case of appendicitis there should be no greater difficulty in making a diagnosis than the physician ordinarily finds in arriving at a conclusion in a case of pneumonia. Every case of colicky pain in the abdomen, suddenly developed, with right-sided tenderness, should be regarded as a case of appendicitis until this supposition be disproved. The accusation should be made, as it were, and the burden of proof should be placed upon the appendix to show its innocence. Every peritonitis is of traumatic origin, whether localized or diffused. All cases of peritoneal inflammation occurring without well-established determining causes other than this should be ascribed to some lesion of the vermiform appendix.

The Diagnostic Value of Leucocytosis.

Proportionate increase of the number of leucocytes, as shown by examination of the blood, is present as a fairly constant symptom in appendicitis, although its presence or absence without other evidence is not diagnostic. In a certain proportion of cases the degree of leucocytosis corresponds approximately with the temperature elevation, although great variations are found in individual cases. A leucocytosis above 20,000 early in the disease (on the first or second day) is suggestive of diffuse septic peritonitis, while this degree at the end of a week or ten days is usually indicative of a local abscess. On the other hand, diffuse septic peritonitis may be present after the first week with a count below 10,000; or this may occur with a mild endo-appendicitis present, or a localized sero-purulent collection with diminished infective virulency. In the absence of the latter feature (diminished infective virulency), and with a tendency for the infective process to spread, a high leucocytosis (above 20,000) is present.[1]

It is difficult to estimate at the present time the exact diagnostic value of the symptom leucocytosis in appendicitis and its sequelæ, or the aid which blood examinations may bring to the surgeon at the bedside. It seems to be fairly well established that 75 per cent. of the cases of acute appendicitis have a count above 13,000, which is the highest count that may occur under normal conditions; and that 73 per cent. of the cases of diffuse septic peritonitis are likewise accompanied by a leucocytosis, or a count above 13,000.[2] These, the cases in which this aid to diagnosis is most available, are precisely the ones in which it is least needed; the practical surgeon, therefore, will rarely be able to avail himself of its use.

Summary of the Most Important Points in the Diagnosis of Appendicitis.

(1) The affection is an acute process in the great majority of cases, both in its commencement and course.

(2) Occasional instances occur in which the course pursued is a subacute one in the beginning, afterwards developing an acute condition. Still more rarely the disease remains subacute or chronic throughout its entire course.

(3) On the other hand, a chronic condition may follow an acute attack, in the course of which subacute, acute or even "hyperacute" exacerbations may occur.

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[1] Greenhough, quoted by Richardson. American Journal of the Medical Sciences, December, 1899, p. 635.

[2] Hubbard. Boston Medical and Surgical Journal, Vol. CXLII, No. 16, p. 409.

(4) For all practical purposes, both of general and differential diagnosis, the terms "hyperacute" and "chronic relapsing" may be disregarded.

(5) In analyzing the symptoms of the disease for bedside use, only the acute and chronic forms are to be considered. In this analysis emphasis is to be placed upon the following points:

Acute Appendicitis.—(1) An almost never-failing characteristic of this form of the disease is the *marked suddenness with which the clinical course is initiated.* The patient may be awakened from a sound sleep, or seized while engaged in his daily routine by sharp, frequently recurring or more or less continuous colicky cramping pains.

(2) In the majority of instances *the pains are referred to the epigastrium or to the neighborhood of the umbilicus rather than to the region of the appendix* at the commencement of the attack. The effects of opium administered must never be lost sight of as a fallacy in masking this symptom.

(3) The symptom *vomiting* may depend to some extent upon the fact of the presence or absence of food in the stomach. Nausea and efforts at vomiting resulting in the expulsion of simple stomach secretion may occur. The administration of cathartic medicines in the commencement of the attack, particularly those of a liquid character, such as castor-oil or solutions of the salines, are quite apt to excite vomiting.

(4) *Pain localized in the region of the appendix frequently fails to attract attention until several hours following the onset of the attack.* Tenderness usually develops earlier. *The latter may be delayed, or its value as a symptom greatly lessened or destroyed by the administration of opium.* A source of fallacy may arise from an *abnormally located ileo-cecal junction,* and confuse the diagnosis by giving rise to an area of maximum tenderness other than at the usual site of the appendix.

(5) The *lower portion of the right rectus muscle is notably rigid,* either at the commencement of the attack or shortly thereafter. This symptom may be delayed, however, and if not present at the physician's first visit in a suspected case, it should be carefully watched for. The best way to determine the presence of this symptom is to palpate the muscle with the finger-tips in a direction

at right angles to its fibres, *i.e.*, in a transverse direction, comparing the sense of resistance imparted to the finger-tips with that obtained by stroking the opposite muscle. *The effects of opium in diminishing this rigidity* and thereby destroying its value as a symptom, as well as the fact that *extensive peritoneal infection may cause both muscles to become equally rigid*, should not be overlooked.

(6) *Increased pulse-rate and rise of temperature may bear no relation to the severity of the attack or its progressive character.* These may be but slightly marked in a case in which perforation and consequent general peritonitis is imminent, on the one hand, while on the other a simple endo-appendicitis (catarrhal) may be accompanied by marked fever. Here again *opium and its preparations may become a source of fallacy.* These, when administered in acute appendicitis, will have the effect of *lessening the pulse-rate* and *lowering the temperature.*

(7) Given a case in which a tumor is present at the commencement of the attack and without a history of a previous and comparatively recent attack, this fact will militate against a diagnosis of uncomplicated appendicitis. *A tumor can rarely be made out until between the second and third days;* frequently it is not discoverable until later in the attack. *A fixed and tender tumor in this region is more than likely to be of inflammatory origin, while a movable and comparatively insensitive mass will, in all probability, prove to be a neoplasm.* The attendant should be on his guard against the following sources of fallacy: (a) In an exceptionally long appendix, inflamed at its distal extremity, the tumor may be found elsewhere than in the ileo-cecal region, this varying with the direction taken by the organ. (b) Cases of left-sided appendicitis, deep pelvic abscesses of appendicular origin, and appendicular abscesses in the right hypochondrium occur as the result of deviations from the normal anatomic disposition of the ileo-cecal junction. (c) Occasionally a tender and *movable* tumor is present in appendicitis, the inflamed organ, under these circumstances, being enveloped in a mass of omentum, which in its turn is not attached to the abdominal wall, hence possessing more or less freedom of movement.

Finally, the fact should not be lost sight of that the local symptoms, combined with the history of the mode of onset, are of the greatest, and the general symptoms of the least value, in the diagnosis of appendicitis.

Subacute Appendicitis.—Cases are occasionally observed in which the symptoms are less acute, even to the extent of almost rendering justifiable a diagnosis of simple indigestion or intestinal colic. In fact, in not a few cases of acute appendicitis a history of preceding subacute attacks that have been treated for "colic" or "indigestion" may be obtained. In other instances an acute attack is not experienced, the patient applying for relief on account of the frequency of recurrence of these subacute attacks. The inflammatory action, in some cases, is so slight that attention is not directed to the ileo-cecal region until the accidental discovery of a tender point. Operation in cases of subacute appendicitis occasionally reveals one or more hardened fecal masses in the appendix or an accumulation of secretion, the latter having undergone suppurative changes. The last-named condition constitutes a true empyema of the organ, in which case a tumor may have been previously made out. In these latter instances obliteration of the lumen of the organ at one or more points exists, either acquired as the result of previous inflammatory disturbances, or congenital in origin.

Chronic Appendicitis.—Cases that have been chronic from the beginning are very rarely observed. The great majority of these that have come under my observation have either given a previous history of one or more subacute attacks or have followed a well-defined acute attack. The points relied upon in making the diagnosis have been the above points in the history, considered in connection with the existence of well-marked tenderness in the ileo-cecal region. In some instances, particularly where a recent attack has been suffered from, an immovable tumor has been demonstrated upon palpation.

CHAPTER IX.

THE DIFFERENTIAL DIAGNOSIS OF APPENDICITIS.

In establishing the differential diagnosis of appendicitis the surgeon will be called upon most frequently to differentiate between this disease and the following:

(1) Lesions of gall-bladder and renal origin.

(2) Lesions originating in the intestine and not of necessity involving the appendix.

(3) Tubo-ovarian disease.

Gall-Bladder Lesions.

Hepatic Colic.—An error of diagnosis may easily be made during the paroxysm of acute pain in appendicitis by mistaking the attack for hepatic colic. The prominent general symptoms of sudden onset, paroxysmal pain, nausea and vomiting, rigid abdominal wall, prostration and an anxious facial expression in rapidly developing appendicitis are common to both. So far as the last three symptoms are concerned, their occurrence is so uniformly present, and so similar in the two conditions, that they may be dismissed as offering no diagnostic advantage. With care an error in diagnosis should not last longer than twenty-four hours, at the end of which time the localization of the symptoms of pain in the right iliac fossa and tenderness at or near McBurney's point is complete.

The same remarks will apply to the occurrence of nephritic colic upon the right side. This is more likely to confuse the diagnosis than hepatic colic.

The following table will show at a glance the points of the differential diagnosis of hepatic colic, nephritic colic, and the initial stages of appendicitis:

Table of Comparison Between :

Appendicitis.	Hepatic Colic.	Nephritic Colic.
Pain.—Peri-umbilical, and referred to the epigastrium as well. Does not radiate above these points. Fixed point of pain in the right iliac fossa.	*Pain.*—Referred to the epigastrium, and radiates toward the shoulder and the point of the scapula. Starts from the region of the gall-bladder as a fixed point.	*Pain.*—Radiates toward the groin and testicles, and sometimes to rectum, giving rise to desire to go to stool and to tenesmus.
Sensitiveness.—Greatest in right iliac fossa. Point pressure reveals an especially tender point upon the outer edge of the rectus abdominis muscle, just below the omphalospinous line (McBurney's point).	*Sensitiveness.*—Extreme beneath the lower border of the ribs. Tenderness over gall-bladder.	*Sensitiveness.*—Greatest posteriorly over the pelvis of the kidney. If tenderness exists in front it is greatest over Poupart's ligament.
Vomiting occurs, but is not persistent, as a rule.	*Vomiting.*—Frequent and intractable.	*Vomiting* not a frequent nor a prominent symptom.
Bladder and Testicle.—Symptoms very rarely present.	*Bladder and Testicle.*—Symptoms absent.	*Bladder* irritable; dysuria and vesical tenesmus; occasionally hematuria. *Testicle* retracted.

Impacted Gall-Stone in Cystic Duct.—A gall-stone impacted in the cystic duct and followed by dropsy of the gall-bladder may give rise to some of the symptoms of chronic appendicitis; the downward projection of the gradually distended gall-bladder may give rise to a tender tumor below the level of the umbilicus and beneath the right rectus muscle; infection of the gall-bladder contents by bacterial migration through its walls, under conditions of extreme pressure from within, may give rise to empyema of the gall-bladder and cholecystitis, which in its turn is followed by febrile movement, abdominal pains and increased sensitiveness, all of which in their subjective symptomatology may simulate appendicitis. The symptoms of this condition may appear suddenly, and simulate an attack of acute appendicitis. The resulting tumor may be located below the umbilicus, and the tenderness be limited to this point.

On the other hand, even without the downward displacement of the gall-bladder, the presence of an unusually long appendix, when inflamed, may complicate the differentiation between this and a gall-bladder lesion.

M. S., aged twenty-eight, female, patient of Dr. Amador, was suddenly attacked with acute abdominal pain, which radiated to the right renal, lumbar and iliac regions. Vomiting followed the onset of the attack. The pains were allayed by very small doses of opium, but a tender tumor was found beneath the outer edge of the right rectus muscle, directly opposite the anterior superior spinous process of the ilium. When I saw her, the second day of the disease, the right rectus muscle was rigid, her temperature was 102° F., and her pulse was 120. She was removed to St. Mary's Hospital for immediate operation. The usual right-sided vertical incision was made and a distended gall-bladder revealed. There was some peritonitis in the neighborhood, and adhesions existed between the gall-bladder and the adjoining coils of intestine, and also the omentum. The gall-bladder was placed abnormally low in the peritoneal cavity, and this fact, together with the unusually rapid symptoms, accounted for the ease with which the case was mistaken for one of appendicitis. The gall-bladder was incised, giving exit to about four ounces of colorless viscid fluid, and finally to some pus. The edge of the viscus was then sutured to the peritoneal wound. The case was one of occlusion of the cystic duct from impacted biliary calculus, which subsequently escaped with the discharges. The symptoms were due to an inflammation of the gall-bladder itself and an accumulation of secretion, which subsequently underwent suppuration.

Dropsy of the gall-bladder, occurring in connection with the presence of a gall-stone occluding the cystic duct, may simulate, by an occasional remission of the symptoms, the chronic relapsing form of appendicitis:

W. V., aged sixty, female, was admitted to my service in the Methodist Episcopal Hospital with the following history: Six weeks previously she was suddenly attacked with acute pain in the right hypochondriac and iliac regions, followed by nausea and vomiting. The pain was finally relieved by opiates and hot fomentations. During the following six weeks more or less pain and tenderness persisted, referred, as she expressed it, "to the right side." On October 31, 1893, two days prior to her coming under my observation, she suffered from a recurrence of the original symptoms. At this time Dr. Brinkman visited her, and discovered a tumor beneath the right rectus abdominis muscle, extending from a point about an inch above the level of the anterior superior spinous process of the ilium, along the ascending colon, for a distance of about three inches. Point-tenderness at the so-called McBurney's point was well marked; at no other point upon the anterior abdominal surface could such extreme tenderness be elicited. There was no jaundice.

A right-sided vertical incision exposed the tumor, which was found to be a distended gall-bladder. There was considerable peritonitis in the neighborhood, and the gall-bladder lay over and upon the ascending colon, to which it was adherent. It was also united by adhesions to the right lobe of the liver. The gall-bladder was opened and emptied of about three ounces of clear, but rather thin mucous fluid. Further investigation showed the presence of a single gall-stone of a conical shape, without facets, and about the size of the last joint of the little finger. The apex of this stone was firmly fixed in the opening of the cystic duct.

With a history of preceding attacks of indubitable hepatic colic and the occurrence of pain referred to the hypogastrium and epigastrium at the commencement of the attack, the case may go on for a considerable time before symptoms of a sufficiently distinctive character are present to suggest even an exploratory incision, as shown by the following case:

M. R., aged fifty-eight, female, was admitted to St. Mary's Hospital with the following history: She had suffered from several attacks of hepatic colic in the past. About six weeks prior to my visit she was suddenly attacked with acute abdominal pain referred to the epigastrium and right hypochondrium. Since the attack she had been confined to her bed with exacerbations of fever and more or less pain referred to the right hypochondriac and iliac regions. A tumor was finally discovered in the latter; its fluctuating character could be distinctly made out by palpation through the abdominal walls. The bulging of the wall at this point was likewise most pronounced.

A right lateral laparotomy revealed a large collection of sero-purulent fluid in the right iliac fossa. Upon emptying this a small opening was found which passed behind the cecum and toward the median line and communicated with another cavity to the inner side of the colon. This second cavity also contained a large collection of sero-purulent material.

Upon exploring the right iliac fossa the appendix vermiformis was found lying in the "SE" position (Fig. 9). A portion of the organ had become detached from the remainder and was readily lifted from its bed of adhesions and removed. No ligature could be applied, and, owing to the patient's unfavorable general condition, it was not deemed wise to continue the operation to the extent of removing the remainder of the appendix.

At no time during the patient's convalescence was there any trace of biliary secretion in the discharges or upon the dressings. The occurrence of fecal communications retarded the recovery, due to sloughing away of the remainder of the vermiform process.

Rupture of the Gall-Bladder.—This error was made in one of my own cases. The accident occurred while the patient was intoxicated, and no definite history could be obtained other than the sudden occurrence of general and severe pain. The tenderness was right-sided, and this, together with the rigidity of the right rectus muscle, and the existence of peritonitis, led to an exploratory incision which revealed the true state of affairs.

Floating Kidney upon the right side, with twisted pedicle, may be eliminated by very much the same line of reasoning as in renal colic. The history of a movable tumor, existing before an attack, will assist in the diagnosis.

Intestinal Lesions.

Appendicitis may be mistaken for the functional disturbance of the intestinal canal known as painter's colic. The following case illustrative of this error in diagnosis came under my care at the Brooklyn Hospital:

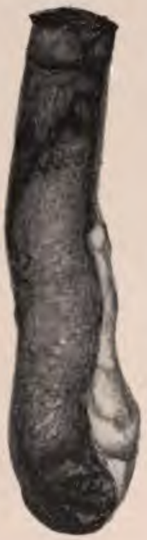
The patient, a man of thirty-two and by trade a house-painter, was admitted on January 27, 1898, at about eight in the morning, with the following history: He had not suffered from previous similar attacks. While at work the preceding day he was suddenly seized with sharp colicky pains, referred to the general abdominal region, and nausea. He continued at work, in spite of the severity of the symptoms, and postponed consulting a physician until evening. The latter diagnosed painter's colic, for which a cathartic was prescribed. He continued to suffer pain, but the next morning again essayed to resume his work. He was quickly seized with increased abdominal pain, and the ambulance was summoned. Upon admission he was found to be suffering from shock, with subnormal temperature, rapid and weak pulse, cold surface, anxious facial expression and rigid and retracted abdominal walls. Immediate abdominal section was performed. The operation revealed the presence of sero-purulent fluid and fecal matter in the peritoneal cavity. The peritoneum was injected as far as visible. The appendix was free from adhesions, inflamed its entire extent and perforated at its distal extremity (Plate XII.).

Lesions originating in the intestine at the ileo-cecal junction, not necessarily of appendicular origin, possess an extreme degree of diagnostic importance. This is particularly true of those involving acute intestinal obstruction, or a perforation of the bowel. Fortunately the latter require prompt operative treatment, in common with acute appendicitis, for which they may be mistaken.

Acute Intestinal Obstruction.—This is suggested by some of the symptoms of appendicitis, particularly if the point of the obstruction is near the ileo-cecal region. The following cases of more than usual interest will serve to illustrate the difficulties of diagnosis in this condition:

J. W., aged twenty-nine, of previous good health, was suddenly attacked with violent abdominal pain referred to the right iliac region, and with vomiting. Upon the occasion of my visit he lay in bed in the dorsal position, his knees

PLATE XII.



Appendix perforated within twenty-four hours of the first symptoms. No foreign body or fecal concretion present.

drawn up, and a most anxious expression upon his face. The skin was of a muddy color, cold, and bathed in perspiration. The finger-nails were blue. The pulse was rapid (130) and feeble; temperature 102° F. Fecal vomiting had been present for two days. No movement of the bowels nor passage of gas per rectum had occurred since the first day of the attack, five days previously. The abdomen was barrel-shaped and highly tympanitic. There existed a point of especial tenderness in the right iliac fossa. No tumor could be made out. A provisional diagnosis of primary appendicitis, with subsequent intestinal obstruction, either from intestinal paresis or angulation, was made. Exploratory laparotomy was advised and accepted.

A vertical incision at the outer edge of the right rectus muscle was made, and the parts about the cecum were exposed. A number of coils of distended small intestine presented themselves. The intestinal obstruction was found to be due to an encircling band, consisting of an unusually long diverticulum (Meckel's), the remains of the vitello-intestinal duct, which had become wrapped around a portion of the ileum close to the ileo-cecal valve. The tip of the diverticulum was attached to the mesentery of a portion of intestine which it grasped by an inflammatory adhesion of recent occurrence.

E. A., female, aged twenty-four, married, had previously suffered from some intra-pelvic inflammatory lesion. She was admitted to my service, at the Methodist Episcopal Hospital, with a history of having been suddenly attacked with severe abdominal pain and vomiting five days before. The pain, at first general, was finally referred to the right iliac region. The vomiting was persistent and uncontrollable, but not stercoraceous. Obstinate constipation existed. Tenderness over the supposed site of the base of the appendix was well marked, and all attempts to divert the patient's attention from this point, when making pressure upon it, failed. On May 15, the day of her admission, a right-sided laparotomy was performed by my assistant, Dr. Delatour. The appendix was found to be normal. The small intestine was bound down by old adhesions in the pelvis and just behind the cecum. Separation of these relieved the obstruction, and the patient made a good recovery.

Cases of true internal hernia are comparatively rare. The following case, which closely simulated appendicitis, is of interest in this connection:

F. A. B., male, aged twenty-one, was admitted to my service at the Methodist Episcopal Hospital, August 21, 1892. Two days before he had been attacked with sudden pain, referred to the right iliac region, and with vomiting. The pain became so severe as to require hypodermatic injections of morphia for its relief. The vomiting became persistent, the constipation complete, and the prostration extreme. The treatment prior to his admission to the hospital had been mainly the administration of opium, but in spite of this and the distention, tenderness was more marked beneath the right rectus muscle and below the level of the umbilicus than elsewhere. A median incision was made, and a hernia of a portion of the ileum into the fossa duodeno-jejunalis of Treves was found, with the musculus suspensorius duodeni of Treitz acting as a band. The patient failed to rally, and died at the end of twelve hours.

The inflamed appendix itself, by acting as a constricting band, may be the cause of the obstruction, and lead to uncertainty in the diagnosis, as is shown by the following case:

A. A., aged twenty-four, was admitted to my service at the Methodist Episcopal Hospital suffering from symptoms of intestinal obstruction. The attack had been marked at the beginning (seven days before his admission) by diffused abdominal pain, followed by vomiting, and finally by pain in the right iliac region. The vomiting persisted, and finally became intractable; the abdomen was distended and tympanitic; the facial expression was characteristic of a grave abdominal lesion; stercoraceous vomiting finally occurred. He was in a condition of great prostration at the time of admission. A median abdominal incision was made for exploratory purposes, and the cause of the obstruction was found to be the appendix. As a result of the inflammation, the tip of this organ had sloughed away, and the stump had become adherent to the mesentery of the ileum, just at its point of attachment, in such a way as to compress the latter against the cecum.

Acute mechanical obstruction, the result of internal hernia, ileus, invagination or strangulation by bands from old inflammatory adhesions, will give rise to symptoms that are characterized by their sudden onset and severity. The pain occurs in exacerbations, and is generally referred to the seat of the obstruction or to the neighborhood of the umbilicus. In the latter case the differentiation will be attended with greater difficulties in the first few hours of the attack than later on, when, if the case prove to be appendicitis, the pain will be centred in the right iliac region; while if intestinal obstruction be present, it will remain centred at the umbilicus or at the seat of the invagination or strangulation. As shown in the cases cited, if the latter chance to be at the site of the appendix the difficulties of diagnosis are greatly increased. On the other hand, the vomiting in appendicitis is not constant or easily provoked, as is the case in intestinal obstruction; in the latter there is also obstinate constipation, with inability to pass flatus. Later on, the vomiting, caused by the voluntary efforts made by the patient, changes to a regurgitation of fecal matter from the reversed peristalsis; the sufferer as he lies upon his side simply ejects from the angle of the mouth what passes into it from the esophagus.

In invagination the occurrence of tenesmus and the passage of bloody mucus will aid in the diagnosis. A tumor may often be made out by both abdominal and by rectal palpation. In strangulation caused by a band of adhesion in the adult, the history of a previous attack of peritonitis will usually be obtained. In children, both band and malposition of portions of the intestinal canal, causing obstruction by strangulation, may result from fetal peritonitis. In ileus a history of pre-existing peritonitis is wanting. In acute intestinal obstruction, from any cause, with advancing peritonitis a rapid and general distention occurs due to the combined effects of the mechanical obstruction and intestinal paresis; in appendicitis and its resulting peritonitis the distention is the result of intestinal paresis alone, and is less rapid in its development.

Chronic Intestinal Obstruction.—Chronic obstructive conditions and neoplasms in this region are of less importance in this regard, for the reason that, as a rule, neither these nor the lesions of the appendix which may be mistaken for them ordinarily require immediate operation. The differential diagnosis between neoplasms of the bowel and appendicitis is to be established by a close scrutiny of the previous history taken in connection with the presence of a comparatively insensitive and movable tumor on the one hand, and an immovable and tender mass on the other. Impacted fecal matter is to be differentiated by the absence of the symptoms of acute appendicitis from the latter, and from the chronic form of the disease by the effects of cathartics and enemata.

Tubo-Ovarian Lesions.

Tubo-Ovarian Lesions of Inflammatory Origin.—The surgeon will probably be called upon oftener to differentiate between appendicitis and tubo-ovarian lesions of inflammatory origin than between the former disease and all others for which it is likely to be mistaken combined. The following table shows the points in the differentiation of appendicitis from these lesions:

	APPENDICITIS.	TUBO-OVARIAN INFLAMMATORY LESIONS.
Frequency.	Proportion of males to females is as 1 to 4.	
History of attack.	Acute onset.	Previous history of infection, with endometritis, salpingitis, ovaritis, and pelvic peritonitis, and coincident progressive menstrual disturbances, may generally be obtained.
Pain.	Usually acute and radiating in acute cases. May be dull and localized in subacute and chronic cases. In acute cases this symptom may be masked by opium.	Dull and localized. The supervention of an acute exacerbation in a chronic pelvic inflammation may give rise to pain sufficiently acute and severe to simulate appendicitis.
Vomiting.	Exceedingly common.	Relatively infrequent.
Tenderness.	Located at the site of the appendix. Maximum point corresponds to or above the level of the anterior superior spinous process of the ilium. Not easily elicited by the vaginal touch.	May be traced to the adnexa. Is located well below the level of the anterior superior spinous process of the ilium. Easily elicited by the vaginal touch.
Chills or rigors.	Of infrequent occurrence.	Not an uncommon symptom in acute exacerbations of adnexal disease.
Fever.	Present, although its grade of no service in estimating the severity of the attack, particularly in the cases in which the temperature is but slightly elevated and the pulse not markedly accelerated.	May be absent, or nearly so, in chronic adnexal disease, until a spread of previously existing infection or the introduction of fresh infectious agents is announced by its presence.
Muscular rigidity.	Only occasionally absent, even in the mildest cases.	Almost invariably absent unless complicated with severe peritonitis.
Tumor.	Present on and after the second day. Usual location beneath the right rectus muscle and opposite the anterior superior spinous process of the ilium, or to the outer side of this area. Easily made out by abdominal palpation ; not easily reached from the vagina.	Usually present when the surgeon is called in. Location upon lower plane than in appendicitis. Easily determined by vaginal touch ; abdominal palpation may fail to reach it altogether because of its low position behind the pubic arch.
Course.	Usually follows an acute course. In chronic cases there is almost always a history of at least one acute attack. Relapses common, and usually acute in character.	A subacute or chronic course from the commencement the rule. Chronicity sometimes disturbed by supervention of acute exacerbation ; even these, as a rule, are not marked by acute characteristics, save in rupture of a pyosalpinx.

Extra-Uterine Pregnancy.—The sudden rupture of the sac of a right-sided extra-uterine pregnancy may simulate appendicitis. The occurrence of great prostration, amounting in some cases to collapse, excessive thirst, air hunger, and other symptoms of internal hemorrhage, the menstrual history and the results of a pelvic examination, will serve to differentiate the two conditions.

Pelvic Hematocele.—Hemorrhage from the pampiniform plexus of the right side will suggest, by the suddenness of the onset and the accompanying pain, an attack of appendicitis. If the hemorrhage is intra-peritoneal, a large quantity of blood may be lost in a short time, and the symptoms of active and excessive hemorrhage develop. In instances where the hemorrhage is extra-peritoneal, the more urgent symptoms due to rapid loss of blood will be absent. A more or less pronounced tumor with a rather doughy feeling, situated between the folds of the broad ligament and felt on vaginal examination lying in one or both lateral fornices, or in the *cul-de-sac* of Douglas, will be found. In addition to this, some irregularity in the menstrual period immediately preceding the attack, and in some cases the recurrence of the flow after the regular menstrual flow has ceased, will all be diagnostic points of value.

Further, one should not fail to take into account the possibility of the coexistence of chronic and acute lesions of the adnexa and appendix, or the simultaneous presence of an acute lesion of the one and a chronic lesion of the other. The presence of the appendiculo-ovarian ligament of Clado furnishes a route of bacterial migration from the intestine to the right ovary. The presence of the *bacillus coli communis* has been demonstrated by Kiefer in an ovarian abscess, and I have found the appendix directly attached to the right ovary, inflammatory conditions of both coexisting. The focal lesion in these cases probably exists in the appendix.

Of the rarer conditions known to have been mistaken for appendicitis may be mentioned a case in which a lithopedion escaped from a right Fallopian tube (Martin, of Berlin); a fibro-myoma of the ileo-cecal region (Sonnenburg); a small suppurating dermoid (Bergmann); a ruptured right rectus muscle occurring while the patient was under the influence of liquor, and a ruptured gall-bladder under the same circumstances (my own cases). I have been compelled to reopen the abdomen a second time in two cases in which adhesions formed between the stump of a removed right ovary and tube and the appendix gave rise to symptoms of appendicitis. Since these experiences I have made it a rule to remove the appendix, when intra-peritoneally located, in all cases of abdominal section.

Morbus Coxarius.—The flexion of the thigh upon the abdomen, together with lateral inclination of the pelvis, occurring in young children, from whom it is difficult to obtain an intelligent statement as to the seat of pain and tenderness, may lead to an error confounding this disease with morbus coxarius (Gibney).

Typhoid Fever and Entero-Colitis.—Attention to the cardinal symptoms of appendicitis and a knowledge of the clinical course of these affections should prevent the intelligent practitioner from confounding an attack with typhoid fever or with entero-colitis, yet I have seen both of these errors of diagnosis made by physicians of intelligence and repute.

Finally, the difficulties which may present themselves in establishing the diagnosis of appendicitis in the male sex under circumstances of an exceptionally long appendix passing deeply into the lesser pelvis are not to be overlooked. Sonnenburg reports two such cases where the primary abscess was situated in the Douglas *cul-de-sac.*

In order to still further facilitate the differential diagnosis of appendicitis, the following *résumé* of the conditions most likely to be mistaken for that affection has been prepared. For purposes of comparison, the list in each division is preceded by a similar *résumé* of the symptoms of the variety of appendicitis for which the particular lesions under discussion have been mistaken. This study is based exclusively upon cases that have been admitted to my hospital service with a diagnosis of appendicitis, and of which one of the following existed:

ACUTE CONDITIONS.

Acute Appendicitis.

Anamnesis, etc.—Most frequent in males (80 per cent.). Rare at the two extremes of life. Previous good health immediately preceding present attack, as a rule. History of previous attacks in a certain proportion of cases. Sudden onset.

Pain.—Cramping or colicky and rather constant. Most acute in epigastrium and region about the umbilicus; more or less diffused later on, and may finally centre in right iliac region.

Nausea and Vomiting.—Present in great majority of cases. Usually ceases when contents of stomach are vomited, unless extensive peritoneal inflammation occurs early. Rarely persistent and intractable.

Tenderness.—Markedly localized in the centre of the right iliac region at the commencement, but becoming more diffused with the extension of the peritoneal inflammation. Is frequently marked along the middle of Poupart's ligament. In the rare cases of non-descent of the cecum the tenderness may extend to the parts immediately below the umbilicus or be located to the left of the median line. Present, although in lesser degree, in the direction of the ascending colon, particularly when the appendix lies to the outer side of the colon and points directly upward. When the appendix is extra-peritoneally situated the tenderness may be pronounced in the lumbar region.

Muscular Tension.—Right rectus muscle tense at its lower part. Rigidity pronounced in proportion to peritoneal involvement.

Tumor.—Rarely present before the lapse of forty-eight hours following the attack, and may be delayed until the third or fourth day. Its location is quite constant in the right iliac region but may vary with abnormalities in the location of the cecum. Is immovable and usually rounded and smooth.

Impairment of Function of Intestinal Canal.—Distention of coils of intestine in the neighborhood. Bowels may be moved by enemata and cathartics before diffuse septic peritonitis sets in.

Fever.—Slight elevation of temperature and acceleration of pulse in the commencement, but not a trustworthy guide in their relation to the threatened severity of the attack, particularly when these symptoms are not marked.

Subphrenic Peritonitis.

Anamnesis, etc.—History and mode of onset will vary with source of peritonitis. Arises most frequently from perforating ulcer of stomach or duodenum; next in frequency from appendicitis. Abscess of the kidney, cholecystitis, lesions of the pancreas and perforation of intestine elsewhere furnish examples.

Pain.—Pain severe and more constant and less colicky and lancinating in character than in appendicitis. Located in upper part of abdomen.

Nausea and Vomiting.—Not marked unless peritonitis becomes general. When due to ulcer of the stomach the vomiting precedes the attack.

Tenderness —Localized in epigastrium or hypochondrium.

Muscular Tension.—Limited to region above umbilicus. Drawing in of the intercostal spaces, one after another, as contraction of the diaphragm takes place, is of importance as a diagnostic sign.

Tumor.—Not discernible until abscess forms. Then demonstrated by percussion.

Impairment of Function of Intestinal Canal.—Not marked.

Fever.—Varies with infection. With formation of abscess becomes more marked.

Gall-Bladder Lesions.

Anamnesis, etc.—Cholelithiasis, the most common underlying cause, occurs five times more frequently in females than in males, and in those over thirty, as a rule. Dropsy and empyema usually preceded by indefinite feelings of distress referred to region of gall-bladder; less frequently by recurrent attacks of hepatic colic, not necessarily accompanied by jaundice. Perforation by gall-stone, supervention of suppuration in dropsy, and the occurrence of acute inflammation of gall-bladder marked by sudden onset.

Pain.—Less acute and colicky in dropsy and resulting empyema than in acute inflammation of gall-bladder and perforation from gall-stones. In the latter equally so with appendicitis. More distinctly localized in the commencement in all these than in appendicitis. Generally referred to right hypochondrium.

Nausea and Vomiting.—Absent as a rule.

Tenderness.—Present. Marked in acute inflammation and perforation. Less in empyema. Occupies a somewhat larger area in the right hypochondrium than that which is characteristic of appendicitis in the right iliac region, but may extend below the line of the umbilicus when the gall-bladder is greatly distended.

Muscular Tension.—Upper portion of right rectus, and sometimes both recti, more or less rigid.

Tumor.—Generally present when patient comes under surgeon's care. Is rounded, smooth, immovable, and usually found at normal site of gall-bladder. Exceptionally, and under circumstances of considerable distention, may reach below umbilicus.

Impairment of Function of Intestinal Canal.—None as a rule. There may be some distended coils in the neighborhood.

Fever.—Present, and pulse correspondingly accelerated.

Acute Intestinal Obstruction.

Anamnesis, etc.—*Invagination:* Two-thirds of the cases occur in males, one-third in females. Three-fourths of all cases of invagination are in the neighborhood of the cecum. It is especially an accident of the young (34 per cent. under one year and 56 per cent. under ten). *Volvulus:* Eighty-seven per cent. occur in large intestine; of these one-half occur in the neighborhood of the sigmoid flexure, and less than one-third in the ileo-cecal region. Occurs in males in the proportion of two to one. Most frequently absent between the ages of thirty and forty. *Obstruction by abnormal contents or foreign bodies:* Almost 50 per cent. due to gall-stones; 43.5 per cent. due to fecal impaction; remainder due to enteroliths and substances swallowed. Obstruction by gall-stones three times more common in females than in males and usually in patients past fifty. The ileo-cecal region is the most frequent seat. Usually preceded by hepatic colic, jaundice, or symptoms pointing to the entrance of the gall-stone into the intestine by ulceration through the gall-bladder and bowel-wall. *Internal strangulation:* The most frequent cause of intestinal obstruction (35 per cent. of all cases); 90 per cent. in the small intestine; 83 per cent. in lower abdomen; 67 per cent. occur in the right iliac fossa; 70 per cent. occur in males; 40 per cent. occur between the ages of fifteen and twenty; of these, inflammatory adhesions cause the strangulation twice as often as vitelline remains (Meckel's diverticulum and persistent remains of vitelline blood-vessels). Relatively uncommon in childhood; when it does occur is usually caused by vitelline remains. *Strangulated diaphragmatic hernia* occurred in 10 per cent. of 1134 cases of internal strangulation (Lichtenstein). Usually regarded as a very rare condition. Internal strangulation when due to *adhesions* may be preceded by history of some inflammatory abdominal or pelvic lesion, recent or remote. *Invagination* and *volvulus* give no preceding history. *Obstruction by gall-stone* is usually preceded by jaundice, hepatic colic, or symptoms pointing to entrance of gall-stone into the bowel by ulceration through the gall-bladder and bowel-wall. In strangulated diaphragmatic hernia there is almost always a history of severe injury, although the original condition may be congenital.

Pain.—Severe and intermittent at first; finally rather constant, with acute exacerbations. Location has no diagnostic value in differentiating between the different forms , most frequent in the neighborhood of the umbilicus. Does not become localized.

Nausea and Vomiting.—Frequent and persistent. When contents of stomach are vomited the vomitus is first bilious, then yellow and finally fecal.

Tenderness.—Limited ; less easily differentiated

Muscular Tension.—General rather than limited to lower portion of the right rectus.

Tumor.—Rarely present except in invagination, when it may be fixed after inflammatory action occurs. Occasionally found in obstruction by foreign bodies, when it is mobile.

Impairment of Function of Intestinal Canal.—Constipation complete; passage of flatus absent. Tenesmus in 15 per cent. of cases of volvulus and in 55 per cent. invagination. Bloody discharges. Tympany present, increasing with the duration of the obstruction.

Fever.—Pulse more or less accelerated, increasing in frequency with duration of obstruction. Absence of fever in the beginning rather characteristic.

Perityphlitis and Paratyphlitis.

Anamnesis, etc.—Exceptional and of rare occurrence, as compared with appendicitis. Follow inflammatory condition of cecal wall (typhlitis) and of its serous covering (perityphlitis), having its origin in fecal accumulations. History of loss of appetite, disturbance of digestion and constipation. More or less sudden in occurrence, but less abrupt than in appendicitis. The first acute symptoms may be due to ulcerative perforation of the bowel-wall.

Pain.—Dull and constant, and less diffused as compared with that of appendicitis, usually limited to right iliac region from commencement.

Tenderness.—Present and limited to area involved. Less acute than in appendicitis.

Muscular Tension.—Marked in proportion to acuteness of the symptoms.

Tumor.—Present early in cases of stercoral origin, in which case the tumor will present as a sausage-shaped mass in the cecal region, which may be indented with the finger. When suppuration has taken place tumor will present same characteristics as in suppurative appendicitis.

Impairment of Function of Intestinal Canal.—Constipation, overcome by cathartics, which in the early stages of the affection sometimes relieve all the symptoms.

Fever.—Slight fever in commencement. With advancing suppuration, becomes more pronounced.

Ruptured Pyosalpinx.

Anamnesis, etc.—Comparatively infrequent. Pelvic inflammation. Gonorrheal or other infection. Pelvic distress and pain varying in intensity; menstrual disturbances. Onset sudden.

Pain.—Severe, diffused, constant and of long duration.

Nausea and Vomiting.—Rarely present or marked until diffuse septic peritonitis sets in.

Tenderness.—Extreme and general below umbilicus. Location of tenderness made most easily manifest by vaginal touch.

Muscular Tension.—Absent until diffuse septic peritonitis occurs, which supervenes rapidly in case of rapid emptying of abscess cavity.

Tumor.—Sensitiveness usually so great that induration can only be felt by vagina, and then not always satisfactorily as a distinctly defined tumor.

Impairment of Function of Intestinal Canal.—Not present until intestinal paresis and finally complete paralysis of peristalsis from diffuse septic peritonitis occurs.

Fever.—Steady and marked increase in pulse-rate and rise of temperature.

Ruptured Ovarian Cystoma.

Anamnesis.—Relatively infrequent. History of previous menstrual disturbance may sometimes be obtained. Pelvic symptoms may not have been marked previous to rupture. Latter may sometimes be traceable to lifting effort or recent bi-manual pelvic examination. In larger cystomas history of pre-existing tumor may be obtained. Suddenness of onset of acute symptoms and the rapidity of advance of the latter will depend upon infectiousness of contents.

Pain.—Will depend upon rapidity of development of peritonitis, this being dependent upon last named.

Nausea and Vomiting.—May occur in cases in which peritoneal involvement occurs early.

Tenderness.—Depends upon extent of peritoneal involvement. Usually located in pelvic region, and more readily demonstrable by vaginal touch. With advancing peritonitis becomes more general.

Muscular Tension.—Not present as an early symptom. Its subsequent development depends upon course of peritonitis.

Tumor.—If contents of cyst have escaped, no tumor will be discoverable.

Impairment of Function of Intestinal Canal.—Not present until development of peritonitis causes intestinal paresis, either localized or more or less general.

Fever.—Slight in commencement. Progressive rise of temperature coincident with spread of peritoneal inflammation.

Ruptured Ectopic Gestation: Pelvic Hematoma.

Anamnesis, etc.—The first-named more frequent in its occurrence than formerly supposed (thirty-five times out of 3500 autopsies: Formad). Less frequent in young primiparas than in older multiparas. Symptoms referable to normal pregnancy (absence of menses, nausea, swelling of breasts, softening of cervix, etc.). A bloody vaginal discharge may take place subsequently to last menstruation. Labor-like pains, bloody vaginal discharge, and if the pregnancy is advanced the casting off of a decidua may precede the rupture of the fetal sac. Onset sudden; symptoms of collapse and internal hemorrhage occur in both.

Pain.—Acute and diffuse over lower portion of the abdomen. Is of short duration.

Nausea and Vomiting.—Absent.

Tenderness.—Not localized, if present.

Muscular Tension.—Absent until peritonitis sets in, then general.

Tumor.—If patient survives primary rupture sufficiently long, the physical signs of pelvic hematocele or pelvic hematoma may be found. These distinguishable by conjoined manipulation and are more easily determined from the vagina than from the abdominal surface. In many cases identification of tumor not at once possible even under an anesthetic.

Impairment of Function of Intestinal Canal.—None.

Fever.—With profuse hemorrhage, pulse rapid and feeble, temperature subnormal, later rising slightly. General symptoms of acute anemia present, such as pallor, thirst, air-hunger, etc.

Acute Torsion of Right Ovarian Cystoma.

Anamnesis, etc.—Occurs in about 10 per cent. of cases of ovarian cystoma. Occurs most frequently in small tumors. If tumor is large, a history of such may be obtained. History may disclose certain movements as the exciting cause. In two out of four cases observed by the writer the symptoms came on while the patients were leaning over a wash-tub engaged in rubbing clothes upon a washboard. Sudden onset.

Pain.—Violent pain in the right side of abdomen.

Nausea and Vomiting.—Generally present.

Tenderness.—Considerable area of tenderness below and to the right of the umbilicus.

Muscular Tension.—Present and somewhat general. Localized rigidity not marked.

Tumor.—Present. Increases rapidly in size.

Impairment of Function of Intestinal Canal.—Absent.

Fever.—Absent in the commencement.

Torsion of Right-Sided Hydrosalpinx.

Anamnesis, etc.—Rare. The writer has seen but one case and finds no other in the literature. Disturbances of menstruation (frequent, painful, and prolonged flow). Pelvic distress incident to pelvic inflammation in general. Sudden onset.

Pain.—Acute pain referred to entire right side of pelvic region.

Nausea and Vomiting.—Absent.

Tenderness.—Localized and marked just above bony brim of pelvis.

Muscular Tension.—Absent.

Tumor.—Located just behind insertion of right rectus muscle and extending to the right about half way to Poupart's ligament.

Impairment of Function of Intestinal Canal.—None.

Fever.—Pulse accelerated. No fever.

Right-Sided Hematosalpinx.

Anamnesis, etc.—Infrequent in occurrence. Previous history of menstrual disturbance, the flow usually appearing too frequently and lasting beyond the usual time. Dysmenorrhea. Onset of symptoms rather sudden and usually due to escape of blood from distal end of tube and resulting localized peritonitis.

Pain.—Not marked save when peritonitis occurs. May be at first localized, afterwards referred to the pelvic region generally.

Nausea and Vomiting.—Absent.

Tenderness.—Not well marked by palpation from the abdominal surface. If present is below the level of the middle of Poupart's ligament. Usually easily elicited by the finger in the vagina.

Muscular Tension.—Absent as a rule.

Tumor.—If felt from without is well below the level of the middle of Poupart's ligament. Is much more readily distinguished from the vaginal than from the abdominal surface.

Impairment of Function of Intestinal Canal.—None.

Fever.—Varies with the acuteness of the inflammatory conditions. Fever *not* a marked feature.

Acute Peritonitis.

Anamnesis, etc.—Frequency depends upon affections underlying the attack. Idiopathic or primary peritonitis probably never occurs. *Perforative peritonitis* usually results from acute appendicitis, typhoid ulceration, foreign bodies, penetrating wounds, intestinal obstruction, strangulated hernia, blows upon the abdominal surface, and excessive handling of the intestines in the course of operations involving opening of the abdominal cavity. *Infective peritonitis* is caused by extension of infection from inflammatory lesions of the uterus and Fallopian tubes in the female, ruptured ovarian cystoma, suppurative hepatitis, gall-bladder affections, suppurative kidney lesions, and operative infection. *Symptomatic peritonitis* occurs in the course of an acute or chronic disease such as pleurisy or pneumonia. *Tubercular peritonitis* usually pursues a chronic course. *Syphilitic*, *rheumatic* and *gonorrheal* peritoneal infection very rare.

Pain.—Varies with the virulence of the infection and the rapidity of the extravasation. At first localized, afterwards becoming general; may not be sufficiently prominent to occasion complaint.

Nausea and Vomiting.—Early, persistent and intractable nausea and vomiting almost invariably present. Contents of stomach first vomited, then bile, and finally, in fatal cases, material from small intestine. Hemorrhage from mucous membrane causes a dark-brown vomitus.

Tenderness.—At first localized at point of original infection, then becoming generalized.

Muscular Tension.—Progressively increases from original focus of peritoneal infection until in diffuse septic peritonitis the entire muscular abdominal wall becomes excessively rigid.

Tumor.—None present in diffuse peritonitis. When more or less circumscribed a sero-purulent collection may occur in the course of time and give rise to a tumor.

Impairment of Function of Intestinal Canal.—Early occurrence of paralysis of peristalsis and resulting intractable constipation. Distention due to the forcing of gas from the still functionally unimpaired portion of intestinal canal into the paralyzed coils. In some instances the entire tract is almost simultaneously paralyzed, in which case distention may be less marked or absent.

Fever.—The pulse is rapid, out of all proportion to the rise of temperature. Fever is present as a rule.

Paroxysms of Pain Due to Right-Sided Movable Kidney.

Anamnesis, etc.—Proportion of women affected greatly in excess of males. Most frequent between the thirtieth and fortieth years. Right kidney twelve to thirteen times more often affected than left. Child-bearing appears to have a decided influence in its production. Previous history of symptoms of movable kidney,—viz., dragging, weight and dull pain in loin and side of abdomen, aggravated by exercise and relieved by rest. In women, suffering is increased by menstruation and pregnancy. Occasional sense of something moving. History of previous attacks of paroxysmal pain resembling renal colic. Sudden onset if torsion is present, accompanied by suppression or marked diminution of the quantity of urine.

Pain.—Paroxysmal. Referred to the renal region and extending in the course of crural or sciatic nerves.

Nausea and Vomiting.—Frequently present during paroxysms.

Tenderness.—Not a marked symptom. Palpation gives rise to a peculiar sickening sensation.

Tumor.—Present and movable. Characteristic outline save where hydronephrosis has supervened as a result of frequent angulation of the ureter. May usually be traced to or replaced in renal region.

Impairment of Function of Intestinal Canal.—None during attack. Disturbances of the large intestine, either diarrhea or constipation, may form a part of the history.

Fever.—Negative.

CHRONIC CONDITIONS.

Chronic Appendicitis.

Anamnesis, etc.—History of at least one preceding acute attack, as a rule, with relapses. Rarely the clinical picture presents as a chronic condition from the commencement. This, however, may obtain in tubercular infection of the appendix.

Pain.—Referred to the right iliac region between relapses.

Nausea and Vomiting.—Not marked. Generally absent.

Tenderness.—Marked. Located at site of appendix.

Muscular Tension.—Not marked.

Tumor.—Present. Immovable and usually located opposite middle of Poupart's ligament and attached to extreme right lateral lining of abdomen.

Impairment of Function of Intestinal Canal.—Not marked.

Fever.—Not marked.

Abscess in the Abdominal Wall.

Anamnesis, etc.—Is quite frequently of appendicular origin, and therefore may give a corresponding history.

Pain.—Present. Strictly localized at the inflamed point.

Tenderness.—Localized. Greatest at most prominent part of tumor.

Nausea and Vomiting.—Absent.

Muscular Tension.—Not marked. Secondary induration may be mistaken for it.

Tumor.—Present. Fluctuating when sufficiently advanced. May be demonstrated in abdominal wall by patient lying upon the back and voluntarily lifting occiput or feet from table.

Impairment of Function of Intestinal Canal.—Absent.

Fever.—Present. Subject to remissions, as in suppurative processes elsewhere.

Impacted Ureteral Calculus.

Anamnesis, etc.—Previous attacks referable to nephro-lithiasis, viz., lumbar distress aggravated by exercise; pus, blood and albumin in the urine; vesical irritability; pain in testicle, etc. Attacks of renal colic preceding the impaction and diminution of amount of urine excreted accompanying it.

Pain.—Dull, boring, intensified and becoming paroxysmal by spasmodic contractions of ureters. Radiates toward the groin and testicles, and sometimes to rectum.

Nausea and Vomiting.—Not a frequent nor prominent symptom.

Tenderness.—Present, but not so definitely marked or fixed as in appendicitis.

Muscular Tension.—Usually absent. When present, spasmodic.

Tumor.—Absent.

Impairment of Function of Intestinal Canal.—None.

Fever.—Absent as a rule. At no time a marked symptom.

Fecal Impaction.

Anamnesis.—Follows most frequently a constipated habit and is observed oftenest in females and the aged. Favored by sedentary habits. May give a history of previous attacks. Hysterical and hypochondriacal as well as spinal cord affections may form part of the history. Gradual onset.

Pain.—Not marked. Dull and obscure when present.

Vomiting.—Not a characteristic feature.

Tenderness.—Slight as compared with that of appendicitis.

Muscular Tension.—Absent.

Tumor.—Presents itself as a doughy swelling.

Impairment of Function of Intestinal Canal.—Constipation. Sometimes obstruction; but this rarely intractable.

Fever.—Absent.

Tubo-Ovarian Inflammation.

Anamnesis, etc.—History of menstrual disturbances, usually of the too frequent type; flow apt to become dark and clotted. Thin leucorrheal discharge of vaginal origin, and muco-purulent discharge from endometritis. Symptoms gradual in their early development, but occasional acute exacerbations may simulate chronic relapsing appendicitis.

Pain.—Not severe, as a rule, save in acute relapses. With peritoneal involvement it may be sharp, but is constant, and not paroxysmal. Referred to iliac region, extending at times down the thigh and frequently accompanied by backache. Increased by over-distention of bladder and distention of the intestines with gas; pressure, and walking, riding or jarring aggravate it.

Nausea and Vomiting.—Absent as a rule. When present, accompanies supervention of an acute exacerbation.

Tenderness.—Not so marked as in acute appendicitis. More easily elicited by vaginal examination than external manipulation.

Muscular Tension.—Absent.

Tumor.—The formation is an inflammatory mass. Conjoined manipulation maps it out distinctly and locates it in vaginal fornix. Uterus is pushed forward by mass. An exceptionally long appendix may give rise to a similar tumor.

Impairment of Function of Intestinal Canal.—Constipation, as a rule. This may be occasionally due to adhesions between adnexa and intestines. It is most apt to take place upon left side, the sigmoid flexure approximating more closely the left broad ligament. The appendiculo-ovarian ligament takes but little part in inflammatory attachments. Flatulence.

Fever.—Present in the relapses, and absent or nearly so in the intervals.

Carcinoma in the Ileo-Cecal Region.

Anamnesis, etc.—Symptoms come on slowly and are increased by occurrence of constipation. Cancerous growths of bowel most frequently found in large intestine. Ten out of thirty-seven cases involved the cecum (Frank).

Pain.—Dull, with occasional exacerbation of lancinating pain.

Vomiting.—Absent.

Tenderness.—Usually spread over a larger area than in appendicitis

Muscular Tension.—Absent.

Tumor.—Hard, irregular, not of large size and movable through a limited area. Not usually limited to cecum, but involves either ileum or colon.

Impairment of Function of Intestinal Canal.—Obstruction to passage of intestinal contents when disease is advanced. (One case of primary carcinoma of the appendix reported by the writer in the Brooklyn Medical Journal, April, 1897, p. 252.)

Retro-Peritoneal Sarcoma Presenting in the Right Iliac Fossa.

Anamnesis, etc.—Progressive loss of health and strength in youth or early adult life. Less frequently observed in those at or past middle life.

Pain.—Dull, aching, constant.

Vomiting.—Absent.

Tenderness.—Present; not distinctly defined or limited to point of invasion.

Muscular Tension.—In advanced cases the corresponding thigh may be retracted from involvement of psoas muscle suggesting morbus coxarius.

Tumor.—Fixed, smooth and broadly definable.

Impairment of Function of Intestinal Canal.—Absent.

Fever.—Absent.

As a further aid in diagnosis the surface of the abdomen upon the right side may be divided into three triangles, the upper, middle and lower abdominal triangles. These are formed as follows: A line is first drawn from the tip of the ensiform cartilage, passing through the umbilicus, and thence to the upper limit of the symphysis pubis. A second line is drawn from the prominence of the eighth costal cartilage to the umbilicus. A third line is drawn from the umbilicus to the anterior superior spinous process of the ilium.

As will be seen by reference to Fig. 1, three triangles are thus formed: The upper triangle is formed by the vertical line above the umbilicus, the line drawn from the umbilicus to the prominence of the eighth costal cartilage, and the outline of the costal cartilages above the eighth ribs. In this are to be found subdiaphragmatic peritonitis, lesions of hepatic, pyloric, pancreatic, gall-bladder and duodenal origin, and post-peritoneal new growths.

The middle triangle is formed by the line passing from the umbilicus to the eighth costal cartilage, that drawn from the umbilicus to the anterior superior spinous process of the ilium and the anterior margin of the quadratus lumborum muscle. In this space there may also occur, in exceptional instances, the lesions found in the upper triangle, with the exception of lesions of the pancreas; but more particularly empyema of the gall-bladder, lesions of renal and ureteral origin, appendicitis with an upwardly displaced cecum, neoplasms of the hepatic flexure, intussusception and fecal impaction are to be sought for here.

The lower triangle is formed by the line drawn from the umbilicus to the anterior superior spinous process of the ilium, the vertical line extending from the umbilicus to the upper margin of the symphysis and the line of Poupart's ligament. This space is subdivided into two smaller triangles by a dotted line passing from one anterior superior spine to the other. In the upper half of this lower triangle evidences of appendicitis are to be particularly sought for.

The lower triangle is of especial importance in connection with the present study. The diagnosis will be complicated in connection with the contents of the upper half of the triangle by the possibilities of (1) peri- and paratyphlitis; (2) fecal impaction; (3) intussusception; (4) carcinoma in the ileo-cecal region; (5) post-peritoneal neoplasms; (6) osseous growths from the bony pelvis; (7) abscesses originating in dorsal or lumbar Pott's disease, and (8) floating kidney. When the evidence points to the existence of a lesion in the lower triangle, or below the level of the anterior superior spine of the ilium, and a differentiation between this and appendicitis is demanded, it is necessary to eliminate from the consideration, in addition to those just mentioned, the following: (1) distended urinary bladder from retention; (2) ovarian retention cysts and neoplasms; (3) inflammatory tubo-ovarian lesion; (4) neoplasms of uterine origin; (5) ectopic gestation; (6) inguinal hernia, and (7) inflamed ectopic testicle.

CHAPTER X.

THE PROGNOSIS OF APPENDICITIS.

The prognosis of appendicitis is unfavorable in the cases treated non-operatively in proportion to the severity of the infection; and in the cases treated surgically in proportion to the delay in instituting operative interference.

While there are doubtless many cases of endo-appendicitis of a mild character which recover, it is equally true that a very large number of the cases which are lost, both with and without operation, were mild cases in the beginning of the attack. The disease may pursue an exceptionally rapid and uninterrupted course to a fatal termination in thirty-six hours from the beginning of the attack, as is exemplified by the following case:

O. P., aged fifty-eight, was admitted to St. Mary's Hospital at 9 P.M. on April 27, 1892. He was found by the ambulance surgeon sitting in a saloon suffering from acute abdominal pain. He had first felt the pain while straining at stool just before starting for work that morning. A diagnosis of appendicitis was made, and he was removed to the hospital for operation. He was given a hypodermatic injection of morphine on the way to the hospital. This caused so much relief that he afterward refused operation, although it was repeatedly urged upon him during the next twenty hours. The temperature, which upon admission was 102° F., fell, after the full effect of the opiate was obtained, to 99° F., and there remained. He was seized with severe pain at 6.30 P.M. of the day following, and died in collapse within half an hour, just thirty-six hours after the first evidence of the disease. The pulse just before this was 120.

The autopsy, conducted by Dr. Clayland, the assistant pathologist of the hospital, revealed a perforated appendix and rupture of a large, encysted sero-purulent collection into the general peritoneal cavity.

If this case be taken as a type, and the period of time from the administration of opium to the final catastrophe be lengthened from the second to the fifth day, a large number of the cases formerly non-operatively treated would be included in its class.

In the heretofore indifferent position of the profession toward this disease, the cases which were more or less acute in the commencement, but which became subacute in a few hours, were next gravest in character. These are cases in which the opium treatment is not necessarily to blame for allaying the anxiety that would naturally be felt by the practitioner when the gravity of the conditions present was fully recognized. They are rather cases in which necrotic changes in the mucous membrane follow a simple endo-appendicitis. Infection of the submucosa takes place, and a renewal of the symptoms depends upon the supervention of parietal appendicitis, either serous or suppurative. Involvement of the peritoneum (the peritoneal stage of Talamon) or the occurrence of a septic thrombosis and gangrene of the organ follows. The following case is a good example of such a condition of affairs:

J. L., a Swede, was admitted to St. Mary's Hospital with a history of having been suddenly attacked with severe abdominal pain, while lifting a heavy cake of ice, forty-eight hours previously. He had taken a cathartic for the relief of the pain; no other medicine had been administered. Dr. F. E. Wilson was finally summoned, and found the patient sitting up. He complained of pain in the right iliac region. The pain was not severe, nor did the pulse (96) and temperature (100° F.) indicate a severe grade of the disease. He was ordered to bed until the arrival of the ambulance. This injunction he did not obey, and the ambulance surgeon found him sitting in a chair. His friends said he had been up and down stairs several times during the day.

He was made ready for operation immediately after his arrival at the hospital. The usual right lateral incision revealed sero-purulent fluid free in the peritoneal cavity; very scanty adhesions were present. Septic peritonitis was already under way; an appendix perforated at about three-eighths of an inch from the tip, and gangrenous for about one-fifth of its length, was removed.[1] The patient died from the septic peritonitis which was present at the time of the operation.

The striking feature about this case was either the absence of symptoms proportionate to the gravity of the conditions present, or the indifference of the patient to the pain that one would naturally expect to be present in such a case. This form of the disease is calculated to cause the physician to hesitate in the diagnosis, and much valuable time is therefore lost.

Talamon has asserted that this subacute form of the disease corresponds most frequently with the class of cases in which the inflammation occurs in an appendix not covered posteriorly with peritoneum, and in which, therefore, perforation may occur into

[1] See Plate IV.

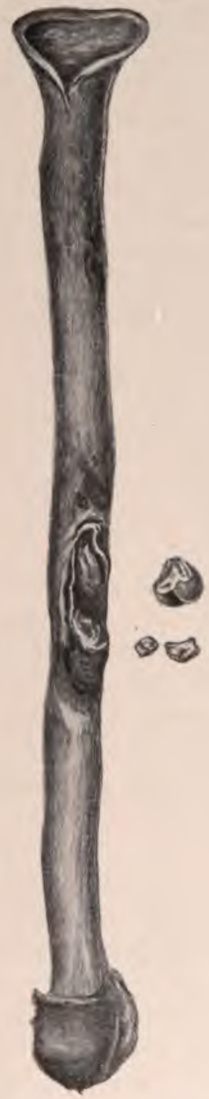
the retro-cecal connective tissue outside the peritoneum. The unfavorable prognosis in this class of cases is due, in his opinion, to the extra-peritoneal suppuration, which, without any obstacle to its advance, infiltrates the neighboring muscles and tissues, and provokes formidable and fatal complications. While I am willing to admit the dangerous character of this, as well as of any other form of the disease, in my experience the cases which become subacute after having been acute, as well as the cases which have been subacute from the commencement, and in addition those in which "cures" are attempted by the use of opium, are all equally and exceedingly dangerous. As an example of the latter class the following case, in which some particularly sad features were present, may be cited:

W. R., a medical student, was suddenly attacked with pain in the abdomen, referred to the right iliac region. A chill accompanied the attack and vomiting followed it. The temperature was 101° F., and the pulse 98. The young man himself made the diagnosis of appendicitis, and a neighboring practitioner was summoned by the family. This practitioner succeeded in shaking the young student's confidence in his own diagnosis, and the patient was given as treatment three grains of morphine and ten grains of calomel daily. He seemed to improve, but on the sixth day a relapse occurred. From this he again improved under a continuation of the same treatment. On the eighth day another advent of acute pain was followed by collapse. He was seen by Dr. R. W. Sharp, who confirmed the young man's original diagnosis, and afterwards by Dr. Delatour. He was carefully removed to the Methodist Episcopal Hospital for operation, but his condition never improved sufficiently to warrant it.

In my judgment, the only cases treated non-operatively in which the prognosis can be said to be favorable are those in which the disease is neither progressive nor stationary, but, on the contrary, is retrogressive within the first twenty-four hours after the attack, *as evinced by the symptom of tenderness*—providing this latter has not been masked by the administration of opium or some of its derivatives.

A careful study of any considerable number of cases only serves to emphasize the importance of resorting to early operation in order to forestall the graver complications which may occur without adequate warning. The only safe course to pursue at this stage of the disease is to remove the offending organ. It has been shown again and again that the dangers arising from the operation

PLATE XIII.



Appendix post-peritoneally situated for the greater portion of its length. Perforation. Enterolite present. (Natural size.)

under these circumstances in competent hands are slight as compared to those attending the conditions present when the disease has extended beyond this stage. Under these circumstances there can be no reasonable excuse, when proper surgical aid can be obtained, for delaying operative interference. The results of my experience compel me to assert and to reiterate the truth of this proposition.

These conclusions are in entire conformity with those of surgeons in general who are brought in contact with appendicitis and who have accumulated a large experience in this disease. Embracing all classes of cases, including those operated upon in which conditions necessarily involving a fatal issue with or without operation are revealed by the latter, as well as those operated upon in the early stages, the mortality of operated cases is less than one-half that following the expectant method of treatment, for this is what the so-called medical treatment amounts to. Finally, sight must not be lost of the fact that not less than 30 per cent. of those cases which recover under the expectant method suffer recurrences.[1]

To sum up the whole matter, the only certain thing about an attack of appendicitis which is not subjected to operative treatment, or in which operation is delayed, is the uncertainty of its termination. Further, the ultimate outcome of an individual case in which the first symptoms subside and recur, as well as in cases subacute from the commencement, differs in no wise, in the event of the supervention of acute inflammatory conditions which are treated by the expectant plan, from those treated by the same method in a first attack, save that the prognosis, if this were possible, is still more uncertain.

The mode of termination may be: (1) By perforation, prior to the formation of proper adhesions, and thus giving rise to fatal septic peritonitis; (2) infection of the peritoneum through the lymphatics or other channels of infection. In these cases the serous effusion may be (*a*) encysted, and subsequently become purulent; or (*b*) non-encysted, and occupy the general peritoneal cavity. In either case suppurative changes may occur. In the case of the encysted variety, a secondary rupture of this will lead to a rapidly fatal diffuse septic peritonitis. (3) The rupture of an appendicular abscess and consequent peritonitis. (4) Septic complications, arising from extension to and infection of the post-peritoneal connective tissue. (5) Gangrenous inflammation of the appendix, of the adhesions which surround it, and of the neighboring parts, including the blood-vessels, giving rise in the latter case to fatal hemorrhage. (6) Pylephlebitis, hepatic abscesses with their sequelæ (purulent pleuritis from extension, pneumonia, etc.). (7) The purulent accumulation may open into the cecum, rectum or bladder, and the patient perish from septo-pyemia, due to repeated reinfection of the original abscess cavity from these sources.

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[1] Dörfler, Münchener med. Wochenschrift, 1899, xiv–xvii; Centralblatt für Chirurgie, No. xxxi, 874.

The mode of death may be from shock and collapse, as happens occasionally in cases of sudden primary perforation (perforation of the appendix without pre-existing adhesions). This condition supervenes, however, much more frequently in secondary perforation (rupture of appendicular abscess, or encysted sero-purulent deposit). Septic peritonitis will destroy life by the combined effects of its own septic products and a stercoremia resulting from the intestinal paresis which follows in its wake. The effects of these septic products are most pronounced upon the circulatory organs, as evinced by the paralysis of the inhibitory cardiac nerve apparatus. Complications and sequelæ both of the disease and of the operative procedure will bring about a fatal result by methods peculiar to themselves.

The prognosis in cases subjected to operative interference will vary with the stage of the case at which the operation is undertaken, with the conditions found when the abdominal cavity is opened and with the skill of the operator both in the manipulative technique and in the judicious employment of antiseptic or aseptic measures. There are some unfortunate sequelæ of laparotomies for appendicitis, as well as for other conditions requiring the opening of the peritoneal cavity, which will be referred to later on.

All of the conditions heretofore mentioned that bring about a fatal termination may produce death after surgical interference, provided they were present before it. In other words, the operation will fail to rescue those already doomed by the existence of diffuse septic peritonitis or septo-pyemic general infection.

The prognosis after operation in the chronic relapsing cases is generally good. In twelve cases operated upon by Bull[1] one proved fatal. In sixty-four cases collected by the same writer, occurring in the practice of other surgeons, not a single death is recorded. Kümmell[2] reports twelve operations, and no deaths.[3] Quénu[4] reports four additional cases operated upon by himself, all of which recovered.

To this are to be added the cases included in the table already given (see page 77), one of which died from intestinal obstruction the result of pre-existing adhesions and in which intestinal obstruction formed a part of the pre-operative history, and the other from diffuse septic peritonitis the result of a co-existing ulcerative enteritis, probably of a tubercular character.

The prognosis in cases of this type of the disease not operated upon cannot, in the absence of definite knowledge upon the subject, be definitely stated. Whether or not the appendix ever fully recovers after one or more relapses is a question which cannot yet be answered. In any case radical operation is more trustworthy than waiting for nature's uncertain methods, and therefore every patient who suffers from chronic relapsing appendicitis should be encouraged to submit to an appendicectomy.

With regard to the prognosis after the occurrence of one or more of the unfavorable conditions heretofore mentioned, it may be said, in a general way, that the element of time will, as a rule, govern the fate of these cases. For instance, a perforation may occur, and yet the surgeon may luckily have succeeded in opening the peritoneal cavity before the escape of any of the contents of the tube. The following case will illustrate this point:

Miss M., aged twenty-two, a patient of Dr. Cruikshank, was placed by him under my care for operation for appendicitis. The usual right lateral incision revealed an appendix free in the abdominal cavity, absolutely without adhesions, swollen to the size of the little finger, and perforated in two places. The latter were minute openings, through which soft fecal matter oozed as the ligature was tightened about the base of the organ preliminary to its excision. The patient made a good recovery.

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[1] Medical Record, New York, March, 1893.

[2] Archiv für klinische Chirurgie, Vol. LIII, Parts 3 and 4.

[3] Seven of Kümmell's cases and one of Quénu's are included in Bull's statistics.

[4] Bull. et Mém. de la Société de Chirurgie de Paris, Vol. XVIII, p. 397.

The prognosis after the supervention of the symptoms of peritonitis will vary according as the surgeon is permitted to interfere while the inflammation of the peritoneum is circumscribed or local on the one hand, or general on the other. With a strictly localized peritonitis, even though this enclose a considerable effusion which has undergone suppuration (encysted intra-peritoneal focus of suppuration), the surgeon still has much in his favor, provided no unfortunate error in the technique permits the septic material to contaminate the peritoneal cavity. The same may be said of appendicular abscess. General peritonitis, without the occurrence of septic changes in its resultant serous effusion, may likewise permit a favorable termination. Even if suppurative changes have occurred in an effusion which is located in the general peritoneal cavity the case is not deemed necessarily hopeless by some surgeons, although the chances of recovery diminish progressively with the lapse of time since the infection of the fluid. The number of cases which recover under these circumstances must be exceedingly small as compared to those that perish. The effused serum forms a culture medium favorable to the development of bacteria, and in a few hours it may be transformed from an innocent serous fluid to a virulent toxic material giving rise to a rapid and general infection before the occurrence of any suppurative changes whatever.

Undoubtedly, under these circumstances, the operative procedure, while it gives the patient the only chance of recovery, tends to hasten the end in cases that prove fatal. The general vital resistance to infection is always lessened by the administration of an anesthetic. It is not an infrequent occurrence to have patients develop the most pronounced general septic symptoms in cases where the condition of the peritoneal cavity is such as to cause surprise that the general symptoms were not more pronounced prior to the operation. What would have happened a few hours later is brought about by the anesthetic and operative procedure. The justifiability of interference in many of these cases is not lessened by this possibility; the necessity for early interference is simply emphasized by it.

With an extravasation of pus, serum, or sero-purulent fluid in connection with fecal matter, revealed by the operative procedure, but one result can be expected. A patient will occasionally leave the operating-room alive, if the surgeon is not too persistent in his efforts to cleanse the peritoneal cavity.

Certain untoward intra-peritoneal complications follow the operation in this as in other cases necessitating the opening of the abdominal cavity. These occur in about the same proportion as in laparotomies in general. They consist in intestinal obstruction due to intestinal paresis, ileus or angulation. The intestinal obstruction due to intestinal ballooning is an almost necessary accompaniment of diffuse septic peritonitis, although the possibility of its occurrence, exclusive of this, is to be borne in mind; the prognosis after this condition is once fully established, in the course of diffuse septic peritonitis from appendicitis, is very unfavorable.

Ileus or angulation, or both, may be present before operation. The latter condition is of more frequent occurrence, and may be due to the manner in which the adhesions form about the ileo-cecal valve. The gravity of the case will be necessarily increased by the occurrence of this accident.

The occurrence of angulation after the operation may be due to adhesions which form between the intestine and some adjoining serous surface that has either been abraded, or has been the site of a former adhesion, or a stump of ligated omentum. The last-named condition occurred in one of my cases.

CHAPTER XI.

THE NON-OPERATIVE TREATMENT OF APPENDICITIS.

The absolute rejection of the operative treatment of appendicitis is only justifiable under circumstances where the consent of the patient, or those responsible for him, cannot be obtained, or when he is placed under conditions such as to prohibit the employment of proper surgical aid.

Cases occasionally come under the care of the surgeon, however, in which the conditions present are such that the risks involved in operating can scarcely be exceeded by those taken in treating the case expectantly. The patient is not able to bear the combined effects of the anesthetic and shock from the operation. He is staggering along under a burden which he is just able to bear and live. Any attempt at interference must necessarily increase the burden temporarily, and he dies before the beneficial effects of the operation can be realized.

Even in mild cases of catarrhal or endo-appendicitis with but slight interference with the blood supply there is a source of danger not heretofore sufficiently dwelt upon. I refer to cases of empyema of the appendix. In this class of cases there is a history of several preceding indisputable, but probably comparatively mild, attacks. In several instances that have come under my observation the appendix has been found greatly distended with a muco-purulent secretion almost to the point of rupture, and with practically no adhesions present. Upon examination after removal it is found that communication with the cecum has been entirely cut off by a stricture—the result of one or more former attacks—at the appendiculo-cecal orifice. Mention is made of this class of cases in this connection in order to emphasize the warning to the medical practitioner that in cases of so-called catarrhal appendicitis, even if these could be definitely made out to be such, the mildness of the symptoms is not a safe guide to follow in determining the question of operative interference.

Turning now to the course to be pursued by the practitioner pending preparations for operative interference, or in the presence of an environment or other conditions justifying a rejection of surgical treatment:

The first care of the attendant will be the condition of the bowels. If constipation exists, an enema should be given, followed by a saline cathartic. To be a safe procedure, however, this treatment must be instituted upon the very first appearance of the symptoms. It is believed that neural and vascular changes may precede the onset of the acute symptoms, these leading to rapidly gangrenous conditions. Under these circumstances violent catharsis may invite early perforative peritonitis. Therefore, unless early and prompt emptying of the intestinal tract can be accomplished it is better to forego entirely this portion of the treatment until after the formation of protective adhesions, which may occupy several days. An enema to clear out the lower bowel, however, should always precede the action of a cathartic. If the case is a progressive one and suppuration takes place, catharsis should be employed very carefully, if at all, for the reason that adhesions rendered tense by accumulation within their boundaries may be easily broken down by forced peristalsis, rupture into the peritoneal cavity taking place with resulting septic peritonitis. The bowels may usually be safely moved by daily enemata after the first few days, the patient being duly cautioned against making any straining effort.

The patient should not be permitted to rise from the bed upon any pretext. Voluntary muscular efforts in bed, such as rising and turning over, should also be avoided. None but absolutely necessary movements are to be permitted, and these should always be made with the assistance of a nurse or other attendant. The possibilities of a violently inflamed and gangrenous appendix lying loose in the cavity of the peritoneum and rupturing upon the occasion of some more or less violent effort on the part of the patient, or forced peristalsis of the surrounding intestinal coils, should insure the most careful watchfulness in this regard. Later on in the case, even when all seems to be going on favorably, this watchfulness should not be relaxed. With the subsidence of the inflammatory condition of this organ, an encysted sero-purulent collection in the surrounding area will do almost, if not quite, as much damage as a primary perforation, if its barriers are broken down and its contents permitted to invade the peritoneal cavity. Absolute and prolonged rest in bed should be insisted upon in a most positive manner by the medical attendant until all threatening symptoms have subsided.

It is not easy to lay down positive rules for the employment of opium in appendicitis. There can be no question that this drug has a place in the therapeutics of this disease; it is difficult, however, to give enough without giving too much. Few practitioners can withstand the temptation to prescribe the drug to the extent of complete relief of pain. If the question of operative interference has been disposed of negatively and finally, and the medical attendant is fully aware of the fallacies in the prognosis which the administration of opium gives rise to,—then, and then only, is its employment justifiable to a limited extent, when other measures fail and the patient is being worn out by pain and restlessness. With the apparent improvement in the symptoms which follow its use, the medical attendant must exercise increased vigilance, lest this fact give rise to indiscretions on the part of the patient, into which the latter is led by what appears to be an abatement of all the uncomfortable features of the disease. If the question of operative interference is still under consideration, and settlement depends upon the course which the case follows, then, in order to determine the progressive or non-progressive character of the attack, and in the patient's own interests, it is best to withhold the drug, or at all events to administer it but very sparingly, in order not to mask the natural symptoms. There will be but slight opportunity for error if no opium is given and steady improvement, particularly in respect to the symptom of localized tenderness, takes place. On the other hand, with no natural and material amelioration of the symptoms, the question of operative interference can be intelligently discussed after the first twenty-four hours of the existence of the disease. If, however, opium or its preparations are permitted to mask the course of the disease, the attendant must remain more or less in the dark as to its actual possibilities.

He will be the more readily deceived as to the indications for operative interference where the decision as to this rests upon the course which the case pursues. Likewise, in cases in which operation is refused or contra-indicated, he will be in ignorance as to the actual condition of affairs within the patient's abdomen, and hence will not realize the necessity for constant vigilance against the occurrence of a catastrophe.

Should it be decided to trust to nature's efforts to resist the further progress of the disease (for this is what treatment by drugs really amounts to so far as "cure" of the appendicitis is concerned), there still remains much to be done by the medical attendant. First, it will be necessary to relieve the patient's sufferings; and, second, the parts about the inflamed appendix must be kept at rest in order to secure the formation of adhesions necessary to protect the peritoneal cavity from direct infection from the site of the focal lesion pending either the subsidence of the appendicular inflammation or other termination of the case. The therapeutics of the case becomes practically limited to the judicious employment of opium, *i.e.*, the smallest possible dose that will keep the patient relatively comfortable. Under the watchful care of an alert practitioner opium may be extremely useful in the treatment of the class of cases in which its employment is admissible; in the hands of one less vigilant and unmindful of its treachery, its usefulness becomes converted into a positive source of danger.

The appearance of an inflammatory mass in the right iliac region should be watched for; palpation, if resorted to at all in seeking for this mass, must be of the gentlest. Its presence may be as certainly demonstrated by percussion, and this method of examination should substitute, as much as possible, that by palpation.

The more acutely painful symptoms now subside. With this and the formation of solid adhesions, the dose of the opium may be lessened or the drug withdrawn altogether. For the purpose of allaying restlessness and perhaps securing sleep at night, some of the less undesirable narcotics—such as tincture of hyoscyamus—or the use of one of the bromides will often be found sufficient.

Local applications are of but little if any use in arresting the disease; the application of an ice-water coil or similar application is frequently declared by patients to afford relief from pain. This effect will permit the employment of a smaller dose of opium,—a decided advantage.

The nutrition of the patient must be kept up, in order to enable him to withstand the effects of the septic material which is being slowly fed into his circulation and distributed to his tissues. The skin and kidneys are important agents in the elimination of this material and should receive attention. The undesirability of administering cathartics for the purpose of forcibly emptying the intestinal canal will suggest a diet which will leave the least possible amount of residuum and still be sufficient for the needs of the system. Milk, white of egg in water, and farinaceous gruels and meat broths are indicated, sufficient variety being furnished to make these acceptable to the patient. Digestive disturbances should be met by change in diet and other appropriate measures of treatment.

Fever seldom becomes a serious feature of the disease, and hence antipyretics are but seldom demanded, and in the case of those synthetically prepared, such as phenacetin, antipyrin, and antifebrin, positive harm may arise from their employment from their weakening effects upon the cardiac muscle in the presence of sepsis. In addition, the use of antipyretics, like opium when injudiciously administered, only tends to mask the real conditions present. Tonic doses of quinine are admissible. Any antipyretic action obtained by the use of the latter is to be carefully weighed in estimating the patient's condition as based upon the temperature indications.

With failing strength strychnia in $\frac{1}{30}$-grain doses in connection with quinine, digitalis or spartein is useful. Nitro-glycerin with caffein assists the eliminative action of the kidneys by raising the blood-pressure and lessening the resistance in the capillaries. These drugs are therefore useful, both in the last-named respect, as well as in their influence upon the flagging heart.

A sudden change in the clinical picture will result from the occurrence of rupture of an intra-peritoneal walled-off abscess or a sero-purulent collection. The partial subsidence of the inflammatory mass will be followed by symptoms pointing to the route selected for the exit of the pus.

CHAPTER XII.

THE TREATMENT OF THE COMPLICATIONS OF APPENDICITIS.

Peritonitis.

The modern treatment of peritonitis is based upon our knowledge of the septic origin of the disease, and the recognition of the fact that its chief danger consists in the absorption of the toxic products of the septic processes, rather than a spread of the inflammation itself. Measures to provide for the safe elimination of these products, therefore, form the most rational therapeutic indication.

Absorption of septic material from the enormous lymph sac constituting the peritoneum occurs through the lymph channels and their stomata opening upon the free peritoneal surface. Large-sized lymph trunks and stomata are present in comparatively large numbers in the area of peritoneum corresponding to the diaphragm, particularly at its central or tendinous portion; these are less numerous in the intestinal area, and are almost entirely absent in the pelvic peritoneum, capillary lymph vessels being alone present in this area.

Infection of the lymph channels leads to the obliteration of these by lymph thrombi the result of lymphangitis. In the case of the larger lymph trunks this obliteration occurs slowly, and sufficient time for overwhelming the organism with septic material elapses before efficient protective barriers are established. In the case of the smaller lymph channels and capillary net-work of absorbents, such as exist in the pelvic peritoneum, the obliterating process takes place with comparative rapidity, and the safety of the organism is correspondingly assured.

Two indications therefore present themselves in the treatment of this complication. The first includes measures to remove as much of the septic material, made up of transuded peritoneal fluid, endothelia forced by the latter from the peritoneal surfaces, lymph flakes, bacteria and toxic débris in general, from the peritoneal cavity,—and the second aims to favor the passage of whatever of this material there is still remaining, or which may subsequently occur, away from the dangerous diaphragmatic and intestinal areas and into the cavity of the pelvis, where the anatomic and physiologic conditions are such as to render its presence comparatively harmless.

In carrying out the first of these indications, in the diffuse septic peritonitis which complicates appendicitis, operative measures are alone applicable, since this complication, in the vast majority of cases, is perforative in character, and hence the employment of cathartics for the purpose of utilizing the natural route for drainage,—namely, the intestinal canal, is inadmissible, since this will tend to favor the spread of still larger quantities of infectious material into the peritoneal cavity from the intestinal canal itself.

The operative procedure, where diffuse septic peritonitis exists, consists in opening the peritoneal cavity, and, after dealing with the original septic focus, thoroughly cleansing the peritoneum by flushing with large quantities of sterilized normal saline solution at a temperature of 110° Fahrenheit, eventration being cautiously employed in aid of this, if necessary, and the systematic removal, where this can be done without injury to the serosa, of patches of fibrino-plastic material. So-called "scouring" or scrubbing of the intestines with gauze to remove lymph patches should not be resorted to. While the removal of these patches is indicated because of the fact that they harbor hordes of micro-organisms, on the other hand, great harm may result from the application of rough methods to the serosa itself. If eventration or disemboweling is resorted to, due and careful provision must be made for the protection of the intestines while outside of the peritoneal cavity. This will consist mainly of preventing any injury to the intestines from rough handling or allowing them to drag upon their mesenteric attachments, and of keeping them well covered with gauze and occasionally pouring over them the saline solution at 110° Fahrenheit, in order to prevent chilling.

The second indication, namely: that of securing the passage of septic material away from the dangerous areas of absorption in the peritoneum, is accomplished by taking advantage of the force of gravity for this purpose. In furtherance of this, I have more recently introduced the plan of placing the patient in the elevated head and trunk position, in order to facilitate the passage of fluids from the abdominal to the pelvic areas of the peritoneum. To accomplish this the head end of the bed is raised so that its plane is from twelve to sixteen inches from the horizontal. The patient is prevented from slipping down in the bed by a large folded pillow placed beneath the flexed knees and resting against the thighs and buttocks. The pillow is prevented, in its turn, from slipping by a piece of stout bandage passed through the folded portion, or securely fastened to the sides of the pillow and secured to the frame of the bed at the sides. The elevated head-and-trunk position offers the additional advantage of assisting materially in relieving the nausea and vomiting, and favoring normal peristalsis and the relief of distention by the passage of flatus.

Since the adoption of this postural feature of the treatment, I have been enabled to save a much larger proportion of cases of diffuse septic peritonitis than ever before.[1]

Artificial drainage is provided for by large glass or rubber tubes carried to the deeper portion of the pelvic cavity, through which strips of gauze or wicking are led for the purpose of favoring escape of the contents of the tube by capillarity. To insure against accumulation of fluid in the tubes, these are aspirated every few hours with a common pipette to which a section of rubber tubing is attached to enable the instrument to reach the bottom of the tube, if curved glass tubes are employed. Provision must be made against forcing the ends of the drainage tubes against the rectum by dressing the projecting ends separately, and *not including* the dressings of the tubes in the binder which secures the dressings of the remainder of the operation wound.

In cases of limited or slowly spreading peritonitis complicating appendicitis, the treatment of the peritonitis is the treatment of the appendicitis itself. Pending the necessary preparations for the operation for the removal of the diseased organ, the elevated head and trunk position should be adopted and the ice coil applied.

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[1] Medical Record, New York, Vol. LVII, pp. 617 and 1029, 1900.

In the treatment of tubercular peritonitis complicating appendicitis, nothing further can be done than the removal of the appendix. The necessary abdominal section is of benefit in these cases. The appendix generally will be found to have taken part in the tubercular infectious process. Great care should be exercised, in this class of cases, in freeing and removing the organ, lest the adjoining coils of diseased intestine be injured and a fecal fistula result.

Spontaneous Evacuation of Appendicular Abscesses.—The treatment to be pursued under the varying circumstances of spontaneous evacuation of the pus will vary with the route taken by the latter. If into the peritoneal cavity, the only hope lies in immediate abdominal section and proceeding in the manner described in detailing the treatment of diffuse septic peritonitis; otherwise the patient's doom is sealed. The patient should be placed in the elevated head-and-trunk position, by elevating the head of the bed, while preparations are being made for opening the abdomen. Failing this, the patient's condition in a few hours is generally such that an anesthetic cannot be administered, much less permit the additional shock resulting from opening the abdomen in the face of the profound collapse and general sepsis which rapidly supervenes.

If the pus is evacuated through the bowels, nothing need be done beyond an occasional low enema. A communication between the intestines and abscess cavity sometimes leads to frequent reinfection of the latter, the frequent repetition of which gives rise to renewal of the symptoms until the surgeon interferes to right the matter by incision and drainage. The resulting fecal fistula may be dealt with by operation later on.

The following case of rupture of an appendicular abscess into the intestinal canal during a former attack came under my care at the Methodist Episcopal Hospital:

A young woman was admitted to the hospital with a history of having suffered from at least two indubitable attacks of acute appendicitis. The first of these occurred five years before, and was followed by the spontaneous evacuation of an appendical abscess into the vagina. About a year ago she was again attacked, the abscess in this instance emptying into the bowel, as evidenced by the rapid disappearance of the tumor in the right iliac region simultaneously with a fetid diarrhea. Since the last attack she has more or less continual disturbance in the right iliac region, this consisting of tenderness and dragging sensations in the ileo-cecal region. In addition, attacks marked by paroxysms of colicky pain and increased tenderness necessitated confinement to bed for several days at a time. She was admitted to the hospital immediately following one of these attacks.

The operative procedure consisted of a lateral abdominal section in the right linea semilunaris, thereby giving ready access to the ileo-cecal region. After separation of a number of old adhesions in the neighborhood of the vermiform appendix, the latter was disclosed in a markedly thickened condition and bridging over a space between its cecal attachment and an adjacent coil of small intestine, apparently as much a part of the latter as of the large intestine. The base of the organ was found to consist of a solid fibrous cord resulting from an occlusion of the appendix at this point. The space represented by the distal four-fifths of the organ, however, was pervious, and found to communicate through its lumen with the cavity of the small intestine to which it was attached.

Typical excision of the organ was performed. In detaching the distal extremity of the appendix from the small intestine the former was cut away and the opening in the latter closed by a double row of Lembert silk sutures.

The patient made a good recovery and was discharged from the hospital at the end of five weeks. The symptoms of which she complained before the operation entirely disappeared.

If the abscess cavity has emptied into the large intestine the outlook is more favorable; by the use of enemata the lower bowel can be kept empty, and the fecal current diverted from the opening in a certain proportion of cases. Cathartics should not be used under these circumstances, the object being to avoid, as far as possible, the presence of liquid fecal matter in the invaded bowel; otherwise the conditions present in the small intestine will be produced and healing of the communication delayed or prevented altogether. In spite of every care, however, reinfection may take place and an operation finally become necessary.

Cystitis resulting from invasion of the bladder must be met by washing out the bladder. Infection of one or both kidneys may result from the bladder complication. When the bladder and intestine are both invaded, and a communication established resulting in fecal matter escaping from the urethra with the urine, the patient's condition is truly pitiable. This complication can only be met efficiently by supra-pubic cystotomy.

The following is a case in point:—

A feeble and broken-down man of sixty-two was admitted to the Methodist Episcopal Hospital with a history of having suffered twelve years previously from an attack of what was diagnosticated as "inflammation of the bowels." So far as could be learned from the patient and his friends, this attack partook of all the characteristics of acute appendicitis, and eventuated in an appendicular abscess. Some time within a fortnight after the attack he passed a quantity of pus with the urine, and shortly thereafter began to pass fecal matter through the urethra. This has continued to escape in small amounts ever since. He was in good health, save for attacks of cystitis incident to the fecal communication, until one year prior to admission, when he began to have severe pain in the perineum and penis, with dysuria and vesical irritability. The pain has kept him confined to the house, and much of the time to his bed, for the past few months. He has frequently noticed temporary obstruction to urination, followed by the passage of small hard bodies by the urethra.

Under an anesthetic the sound detected the presence of a medium-sized vesical calculus. The bladder was opened by the supra-pubic route, with the double object of removal of the calculus and the affording of ready exit from the bladder of the fecal matter which passed into it from the bowel. A phosphatic calculus the size of a horse-chestnut was removed. The right lateral wall of the bladder and the cecum were bound together by inflammatory adhesions; no neoplasm was present. Owing to the patient's feeble condition, no further search was made for the fecal communication. Fecal matter was forced by manipulation from the bottom of a pocket formed by the tension upon the attached bladder wall.

The patient gained rapidly in strength, but declined further operative interference. He was discharged from the hospital at the end of seven weeks, wearing a Bolton Bangs' supra-pubic drainage-tube. His family physician reports that at the present time he is free from vesical symptoms.

The vaginal route for the escape of the pus is the most favorable of all those mentioned. The opening is usually directly into the vaginal cavity, and most commonly in the posterior or right lateral fornix, in which case efficient drainage is usually secured. Boro-salicylic acid (Thiersch's) solution, used as a vaginal douche, fulfils all the indications unless it is found necessary to enlarge the already existing opening.

Invasion of the structures of the thigh by an appendicular abscess offers the indication for evacuation and drainage, in accordance with common surgical principles. This evacuation and drainage become imperatively necessary in case of infection of the post-peritoneal connective tissue; septic processes spread rapidly in the deep structures of the back, and the prognosis is always grave in these cases. The site of the original infection, the appendix itself, should be dealt with at the same time. Invasion of the abdominal wall will demand similar treatment.

In rupture through the diaphragm, in addition to the immediate dangers from flooding the respiratory tract, those arising from septic pneumonia are to be feared. The presence of the discharged pus in the pleural cavity, as well as the resulting suppurative process set up in the pleura itself, involve a grave prognosis, and are to be met by operative procedures, these consisting of evacuation and drainage of the pleural cavity. The latter is best effected after re-section of a portion of a rib.

Suppurative pericarditis will also demand incision and drainage.

Hepatitis of septic origin in which emboli are formed in the mesenteric veins and are swept into the portal circulation is announced by pain and tenderness, jaundice more or less pronounced, and increased constitutional disturbance. The prognosis is grave, although not necessarily hopeless. No specific medication will be of use. Suppurative hepatitis is to be feared, and occurs in a certain proportion of cases. The early recognition and evacuation of an abscess of the liver will offer a favorable prognosis if the collection of pus is localized.

CHAPTER XIII.

THE OPERATIVE TREATMENT OF APPENDICITIS.

The Indications for Operative Interference.

While the physician is very generally first summoned to a patient suffering from appendicitis, the responsibility of the treatment should be shared both by the physician and by the surgeon. The great majority of cases should be treated surgically. Beyond the careful use of salines in the very commencement of the disease, and this only if the symptoms denote a mild type of the affection, the less medical treatment which cases of appendicitis receive the better. Above all things the use of opium must be avoided prior to making the diagnosis as much as possible. Its use masks the progressive character of some of the most important symptoms; with free use of the drug the patient's condition seemingly improves, but a sudden increase of pain, followed by distention of the abdomen, accompanied or followed by rapid pulse and some rise of temperature, announce the occurrence of septic peritonitis. It should not be forgotten that an exceptionally virulent infection may produce septic peritonitis with neither primary perforation of the appendix into the peritoneal cavity nor rupture of an abscess cavity; delay in operative interference in such cases will certainly result in disaster, and interference may fail to save the patient.

The indications for operative interference during an attack of appendicitis may be summed up in a few words: As soon as the diagnosis of progressive appendicitis is assured, the abdominal cavity should be opened and the appendix removed. If opium has been injudiciously administered, and the progressive character of the case in hand is doubtful, it is better to err upon the side of safety, and remove the appendix at once. The conditions present are usually beyond the power of nature to remedy, while, in the hands of a surgeon who pays strict attention to aseptic details both preliminary to and in the course of the operation, the latter entails less risk to life than that which is involved in even a mild attack of appendicitis which remains stationary at the end of twenty-four hours, with all its possibilities of lymphangitic infection of the peritoneal cavity, retained muco-pus within the tube, and rupture of the latter into an unprotected peritoneal cavity; or ulceration and perforation either from the presence of so-called coproliths or inspissated fecal matter imprisoned by constriction within the cavity of the appendix, or from gangrenous conditions alone.

In formulating a definite rule for action in the operative treatment of appendicitis many difficulties are met with. To operate too early may be to operate unnecessarily, but this is always preferable to operating too late and hence unsuccessfully. The fact that operative procedures are quite safely performed where a distinctly outlined and encapsulated abscess cavity is present, provided the surgeon does not disturb its wall, has led Reclus and Schmit, of Versailles,[1] to adopt this period as the stage of election. These surgeons content themselves with simply emptying the pus-cavity. On the other hand, many surgeons advocate operation as soon as the diagnosis of appendicitis is made, whatever its grade of severity. A case demanding operation inside of twenty-four hours from the commencement of the attack is exceptional; but a case which is not practically well at the end of that time should be made the subject of operative interference. The surgeon, however, should by no means limit himself to that period. In cases in which unusually severe symptoms, such as high temperatures and a succession of rigors, are conjoined with exquisite tenderness in the right iliac fossa and an anxious facial expression, the surgeon should not hesitate to give the patient the benefit of an early and radical operation.

Where the patient is not seen by the surgeon until the third, fourth, or fifth day of the attack, the question as to whether or not the operative procedure may be contraindicated by the impossibility of removing the appendix without breaking down the adhesive barrier which has been thrown out is one which is frequently encountered by those engaged in this class of work. As very tersely stated by Richardson,[1] we may be confronted by cases which are in such a condition as to be too late for the early operation, and too early for a safe late operation. In deciding this question, much will depend upon the experience of the operator, and the facilities which he may possess in the shape of skilled assistance and other requisites to meet all emergencies as they arise. With a thoroughly trained first assistant to stand opposite to the operator, and who with thick gauze compresses, wet with a 1–1000 sublimate solution, is able to keep the field of operation well isolated from the rest of the peritoneal cavity, as well as the small intestines out of the way, the operation at this the period of localized peritonitis, with or without encysted sero-purulent collections, is both safe and advisable. It will be almost next to impossible to avoid breaking down some of the adhesions, but with care on the part of the operator and a perfectly trustworthy assistant, removal of the appendix may be accomplished without undue risk of infecting the general peritoneal cavity, even under these circumstances, particularly where the collection lies dextrad of the ascending colon.

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[1] Discussion upon appendicitis before the Surgical Society of Paris. Bull. et Mém. de la Société de Chirurgie de Paris, Vol. XVIII.

If the surgeon is called in after diffuse septic peritonitis has developed, operative measures should still be instituted. Infection of effused serum following peritonitis, not necessarily suppurative, offers sufficiently encouraging results to impel the surgeon to give the patient the benefit of a late interference. The case is not necessarily hopeless even after general suppurative peritonitis has commenced; the chances of recovery, however, progressively diminish with the lapse of time following the beginning of the peritonitis.

In the main, cases of appendicitis requiring operation will come under one of the following heads:

1. Cases in which the question of operation simply resolves itself into that of opening an abscess formed in a mass of adhesions,—conditions which commonly obtain at the end of the first week of an attack in which inflammatory adhesions form,—and which goes on to suppuration.

2. Cases which hold out a reasonable hope that the appendix can be removed with safety, although infection beyond the organ

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[1] The American Journal of the Medical Sciences, January, 1894, page 13.

itself is present. The conditions permitting of this obtain from about the second to the fourth day.

3. (*a*) Cases in which the operation is undertaken sufficiently early in an attack (before or at the end of the first twenty-four hours of the seizure) to give reasonable assurance that the infection is confined to the appendix. (*b*) Cases operated upon after the subsidence of an attack and during the period of quiescence.

In addition to these, cases of doubtful diagnosis come under the surgeon's observation in which the operator must be prepared to carry out a more or less exploratory procedure in investigating, in addition to the appendicular region, the region of the gall-bladder in males, and both this and the contents of the pelvic cavity in the female.

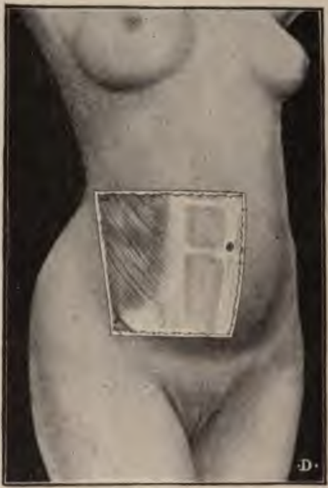
The operation chosen should be carried out with the most rigid attention to aseptic surroundings and conditions, even though infection of the peritoneal cavity is known to have already taken place, or though suppuration be present. There can be no excuse for any failure in the aseptic technique, even under such circumstances.

The Surgical Anatomy.

Before entering into the details of the operative treatment of appendicitis, a brief glance at the anatomy and physiology of the abdominal wall will be of service, particularly with the view of avoiding as much as possible weakening of the latter and the subsequent development of ventral hernia. The abdominal wall is made up of structures whose functions in resisting intra-abdominal pressure vary greatly. For instance, the skin, fat, planes of superficial and deep fascia and the peritoneum, singly or combined, contribute but a small portion of the force-resisting qualities necessary to insure stability of the wall. For this we must look to the muscular structures and their aponeurotic expansions, and of these the latter are of the greatest importance. To conserve the integrity of these structures is therefore of the highest importance, and, following the rule, section of these should be made in the direction of their fibres, in order to favor rapid repair and avoid as far as possible the presence of cicatricial tissue.

The Aponeurosis of the External Oblique.—Of the structures under consideration, the most important is the musculo-aponeurotic expansion known as the aponeurosis of the external oblique (Fig. 14). This broad and dense tendinous expansion affords a comparatively unyielding support to the underlying muscular wall of the abdomen in the situations where this support is most needed. The importance of preserving intact this structure cannot be overestimated, inasmuch as failure of its incised edges to unite leads to bulging forward of the underlying muscle and the final occurrence of surgical hernia.

FIG. 14.

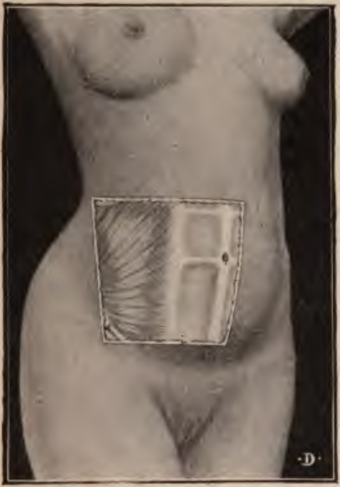


The aponeurosis of the external oblique.

The Internal Oblique Muscle.—The next most important structure is the internal oblique and its tendinous prolongations. The part of the internal oblique which concerns us most is that portion which arises from the middle third of its origin from the crest of the ilium, the fibres of which pass obliquely upward and inward, and terminate in an aponeurosis which divides at the linea semilunaris in such a manner as to embrace the rectus muscle, continuing forward and finally extending to the linea alba (Fig. 15).

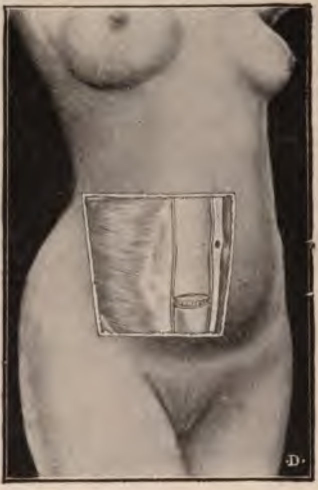
The Transversalis Muscle.—The transversalis muscle, the most internal of the flat muscles of the abdomen, is placed immediately beneath the internal oblique, its fibres, as its name indicates, passing almost in a horizontal direction. The portion of this muscle which is involved in an incision designed to reach the contents of the iliac region is its upper three-fourths, where its aponeurotic expansion to the linea alba passes behind the rectus, blending with that of the internal oblique to form the posterior lamella of the sheath of the rectus muscle (Fig. 16).

Fig. 15



The internal oblique muscle.

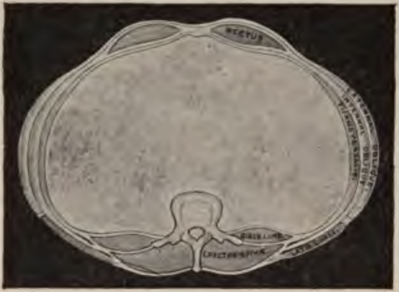
Fig. 16.



The transversalis and posterior lamella of the sheath of the rectus muscle.

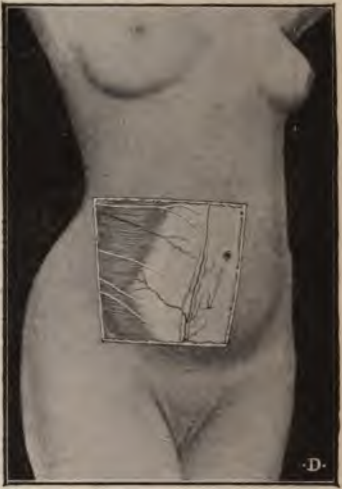
The Rectus Muscle.—Finally, the rectus muscle is to be considered. This structure is of importance mainly because of its function in assisting in controlling the effects of intra-abdominal pressure. Its importance as a surface guide is greatly overrated. In my experience the proportionate width of the muscle varies considerably. That portion which is of especial interest in our present study occupies anywhere from one-third to one-half of the anterior portion of the space located between the median line and the anterior superior spine of the ilium. Its principal interest in the present connection rests in the fact that its sheath is made up of the divided aponeurosis of the internal oblique, this being reinforced by the strong aponeurosis of the external oblique anteriorly, and the tendinous expansion of the transversalis posteriorly, the point where these join before enveloping the muscle constituting the linea semilunaris (Fig. 17).

FIG. 17.



Section of the abdominal wall in the lumbar region, showing the division of the aponeurosis of the internal oblique to form the sheath of the rectus muscle.

FIG. 18.



The transversalis muscle, deep epigastric artery and veins, the eleventh and twelfth intercostal, and ileo-hypogastric and ileo-inguinal nerves.

The Nerve and Blood Supply.—A glance at the nerve and blood supply of this portion of the abdominal wall will be of interest in selecting the site and direction of the incision in operating for appendicular lesions. The eleventh and twelfth intercostal nerves are distributed to the muscles of the abdomen. The last named is so placed as to be crossed by at least two of the usually employed appendicitis incisions (Fig. 18). The first named crosses the linea semilunaris in a position to be injured in case it became necessary to extend the original incision in an upward direction in exploration of the region of the gall-bladder. These two nerves constitute the motor supply to the abdominal muscles. The ileo-inguinal and ileo-hypogastric branches of the lumbar plexus are generally regarded as purely sensory nerves. Be that as it may, the ileo-inguinal nerve sends a filament to the internal oblique, and should the exigencies of the case demand extension of the incision in the direction of the pelvic viscera, the ileo-inguinal branch would more than likely be divided.

These branches of the lumbar plexus pass from behind forward upon the transversalis muscle, between the latter and the internal oblique. The nerve structure of special importance in our present study is the twelfth intercostal. This appears upon the anterior abdominal wall on a level with the lower margin of the umbilicus, where it describes a gentle curve forward and downward to the point where it pierces the rectus muscle. The twelfth intercostal nerve is accompanied by a branch of the twelfth intercostal artery, which is frequently encountered.

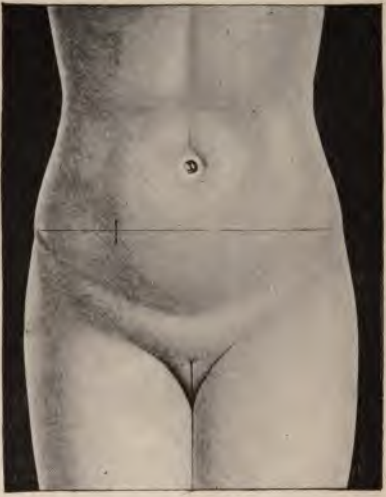
The deep epigastric branch of the external iliac artery also lies upon the transversalis muscle in this region. It ascends vertically behind and just within the outer edge of the rectus muscle, accompanied by its venæ comites. The efferent branches of the latter join the veins at a more or less acute angle, and, unless care is exercised, are apt to be injured in an incision placed parallel with and at the outer edge of the rectus.

The Surface Relations of the Vermiform Appendix.—Opinions differ somewhat as to the surface relations and clinical anatomy of the appendix vermiformis. The cecum, in certain exceptional instances, may be located at points distant from its normal location in the right iliac region, but, when normally situated, the relation of this portion of the large intestine as a whole to a fixed point upon the abdominal wall is fairly constant.

Attempts to arbitrarily fix the exact location of the base of the appendix in its relation to the anterior abdominal wall, however, have proved futile for several reasons, among which may be mentioned the existence of varying points of attachment to the cecum in different individuals, variations in the width of the cecum, conditions of distention on the one hand, and relative collapse of the intestine on the other, and, finally, to the mobility of this part of the large intestine as governed by its peritoneal anchorage. A well-developed meso-cecum is seldom observed.

Ready access to the base of the organ is secured in the largest number of cases through an incision so planned that its centre strikes a point corresponding to the intersection of a line extending from one anterior superior spinous process of the ilium to the other, with a vertical line drawn half way between the median line and the right anterior superior spine (Fig. 19). This differs somewhat from Clado's point, this observer placing the vertical line upon the outer edge of the right rectus abdominis muscle, and locating the base of the appendix at the intersection of this with a line connecting the iliac spines. McBurney locates the base of the appendix at the point where Clado's vertical line crosses a line drawn from the umbilicus to the anterior spinous process of the ilium. The varying width of the rectus muscle and the difficulty of locating this structure in individuals with a thick layer of fat in the abdominal wall constitute a valid objection to the use of this as a surface guide. While the base of the appendix may be sometimes found as high as McBurney's point, in my own experience it has been most frequently located at the point I have indicated.

FIG. 19.



Intersecting lines showing surface relations of the base of the appendix vermiformis.

The Preparations for the Operation.

Inasmuch as, in a large number of cases, it will be necessary to carry out the operative procedure at the patient's own residence, this being particularly true for localities removed from cities or large towns, and in places where properly-equipped hospitals are not at hand, a systematic description of the steps to be taken as soon as the decision to operate has been arrived at will be useful.

A review of the patient's surroundings will be first in order. A room upon the same floor as that in which the patient is already lying should be selected, and due consideration given to questions of light and heat. Whenever possible, all of the necessary preparations should be made beyond the patient's sight and hearing; the patient's confidence in the result is not increased by permitting him to realize how many and various are the precautionary steps to be taken before the risks of the operative procedure itself are entered upon.

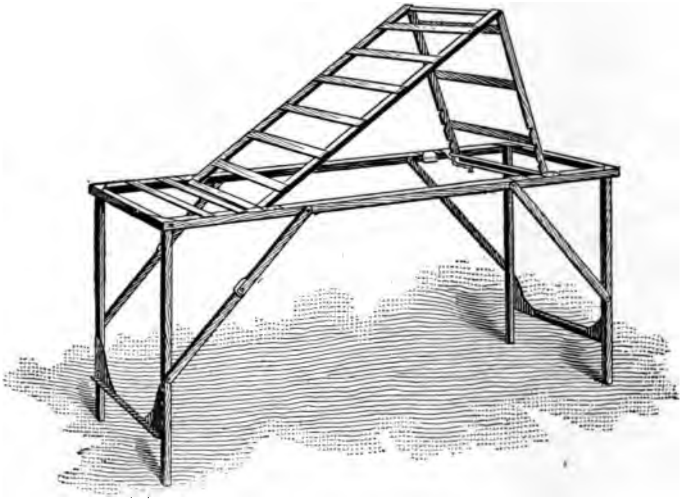
The Preparation of the Room.—This portion of the work may be assigned to the nurse who is to take charge of the case for supervision, or to some member of the family, or to a friend who has sufficient composure to comprehend the necessity for the preparation as well as intelligence to carry out the directions given.

The most suitable apartment being selected, the first step is to remove everything portable from the room, except the carpet. It will generally be easier to disinfect the latter by thoroughly wetting it with a solution of corrosive sublimate than to disinfect the bare floor with its cracks, containing, perhaps, the accumulated dust of several generations. The carpet should be thoroughly *soaked*, not simply moistened. Several gallons of the solution will be required in an average-sized room, and the carpet should be so wet that the water oozes from the latter, when it is walked upon, as water is forced from a wetted sponge when it is squeezed. The edges of the carpet should be particularly looked to, for it is here that dust is apt to accumulate.

The first wetting of the carpet should be done as soon as the furniture, pictures from the walls, mantel ornaments, curtains, hangings, etc., have been removed. It should be wetted again just before the operation. Following the wetting of the carpet, the ceiling, cornices, walls of the room, picture-mouldings, door- and window-casings, and chandeliers should receive attention. These should all be thoroughly wiped with a cloth wetted with the corrosive sublimate solution. If there are any closets opening into the room the doors should be closed and sealed by caulking all cracks with common cotton, plugging the key-hole with the same.

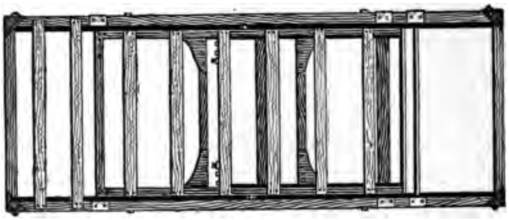
Strips of paper may be pasted over these in addition. If the chandelier is of the ornate variety in use a decade or so ago, and made in patterns of vines, flowers and leaves, it will be almost impossible to thoroughly disinfect this. A sheet, wrung out of the corrosive sublimate solution, may be wrapped about or made to enclose the chandelier like a bag, holes being cut for the passage of the burners, in case these are needed either for the furnishing of light or the use of the gas-stove.

FIG. 20.



Förster's portable Trendelenburg table.

FIG. 21.



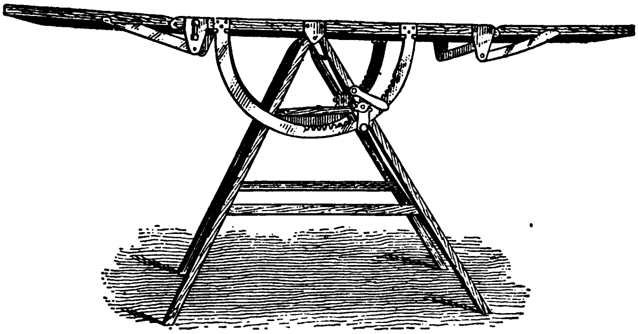
Förster's table folded for transportation.

The surgeon has now to consider what furniture will be necessary for the purposes of the operation. Anything that can be conveniently dispensed with in making up the list of articles should be omitted. The first thing to be considered is the operating-table.

The table designed by Förster combines portability and compactness. The Trendelenburg attachment is easily manipulated (Figs. 20 and 21).

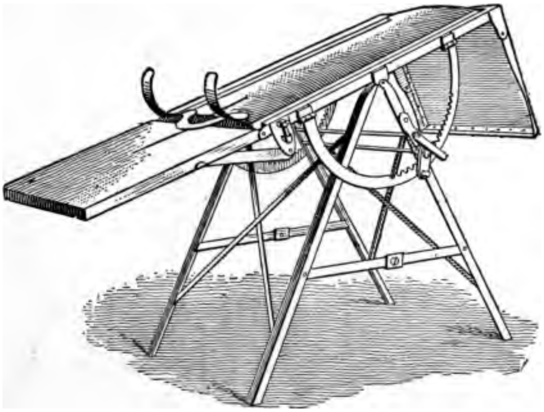
The most complete portable operating-table with which I am familiar is that devised by my former assistant, Dr. Delatour. When set up ready for use it makes a table six feet long (Fig. 22), which can be easily converted from the flat to the Trendelenburg position (Fig. 23). When folded for transportation, it occupies but a comparatively small space (Fig. 24).

FIG. 22.



Delatour's portable operating-table.

FIG. 23.

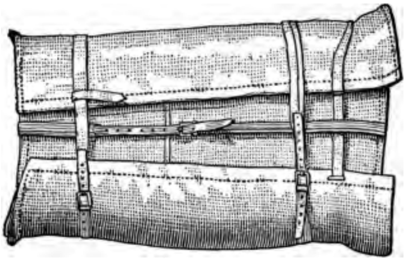


Delatour's portable operating-table in the Trendelenburg position.

The Trendelenburg position is not at all essential in any case, and, under the conditions of many of the cases operated upon in the height of the attack, is positively contraindicated.

In the absence of any specially designed table, a new table, such as is sold by the dealers for kitchen or laundry purposes,

FIG. 24.



Delatour's portable operating-table folded for transportation.

should be procured. Nothing is more certain to defeat the whole preparation thus far made, or to make it absolutely inconsistent, than to take a table from the kitchen, with all of its possibilities of infection, and attempt to use it for the purposes of the operation.

If the surgeon is finally compelled to use a table that has been previously in use, he should have it scrubbed thoroughly with hot water and soap previously to bringing it into the room prepared for the operation. When it is finally placed in the room, in order to make assurance doubly sure, the table is to be covered with a sheet wrung out of a solution of corrosive sublimate, and this so arranged as to completely cover the table, the edges of the sheet reaching to the floor, where they are tacked. If a single sheet is not sufficiently large for the purpose, two or more may be used.

The table is covered with a folded blanket. This should be procured new if possible. It is safer to use this than one that has been in domestic use. When properly folded and placed upon the table, the blanket is to be covered by a sheet from the laundry, and the corners simply pinned about the table. A pillow can usually be dispensed with, and, following the rule already laid down, should be omitted.

Proper provision is now to be made for conveniently placing the instruments, dressings, and other requisites to a properly conducted aseptic or antiseptic operation. At least two small tables will be required. These may also be such common tables as can be procured at a trifling cost, and should be perfectly new, if possible. If those already in use are used they should be cleansed, and the same safeguards placed around them as in the case of the operating-table, except that the sheets covering them need not be tacked to the floor, but pinned closely around the top and legs. The mantel-shelf of the room may be utilized for the anesthetizer's outfit if but two tables can be obtained.

In addition to the two smaller tables two or more of the common wooden-bottomed chairs, such as are used in the kitchen, will be useful. These should be procured new, if possible; when this cannot be done, those used must be thoroughly cleansed and protected in a manner similar to the method employed in the case of the tables. These chairs will be found convenient for placing washbowls at suitable points, as well as for the gas-stove, alcohol-lamps, sterilizers, etc.

As a part of the preparation of the operating-room, it will be necessary to provide facilities for heating water, sterilizing instruments, compresses and dressings. In the city almost every household has a gas-stove, or such can be obtained from the nearest hardware-store. A kerosene-stove will answer the purpose, but is not so cleanly. I very much prefer the large alcohol-lamps or stoves, so generally used by picnic parties and easily procured. In the country the kitchen-stove is always available.

It will also be necessary to provide at least four large washbasins. These may be of granite-ware, if they can be obtained; porcelain washbowls are next best. Metal basins unprotected by a glazing of porcelain, or similar covering, will be attacked by the corrosive sublimate solution. The combination formed, if the basin is made of tin plate (iron covered with a coating of tin), will not do any particular harm, for the reason that the salts of tin are quite efficient antiseptics of themselves.

At least two irrigation-bags should be provided. The combination of hot-water bottle and douche, now made by the rubber companies, will be found very convenient. The family fountain-syringe is more than likely to be foul and unfit for the purpose. When it is possible to procure a brand-new douche-bag this should be done.

The Preparation of the Patient.—If the operation is performed in the period of quiescence, and sufficient time can be had for a complete preparation of the patient, this should be done as follows: Upon the day preceding the operation the bowels are to be thoroughly moved by means of sulphate of magnesium, in half-ounce doses, one or more of which may be given at intervals of from two to four hours. Following the administration of the cathartic no solid food should be allowed. A simple diet of sterilized milk, or, at the most, thin broths or soups, must suffice for the day preceding the operation. A full bath and inunction of vaseline tend to insure a healthy action of the skin and add to the comfort of the patient.

The entire abdominal surface should be thoroughly scrubbed and shaved. This should include the pubic region and the genitals. Washing with a 1–1000 corrosive sublimate solution should follow. A large compress of cheese-cloth or Turkish towelling material should be thoroughly wetted in a boro-salicylic solution (Thiersch's) consisting of fifteen grains of salicylic acid and ninety grains of boracic acid in a pint of water. This compress, sufficiently large to cover the abdominal and pelvic regions, both anteriorly and laterally, must be thick enough to retain a considerable amount of the solution. Twelve thicknesses of cheese-cloth, four of common towelling, or two of the Turkish towelling, will suffice. This is to be covered with a layer of oil-silk, and the whole held in place by means of a firm binder snugly pinned about the patient's body, and prevented from slipping by two perineal straps. The binder itself may be of Turkish towel material.

In addition to the antiseptic properties of the boro-salicylic solution, it possesses the additional advantage of softening and assisting in the loosening of the dead epithelium which is present in varying quantities upon the skin, even after a bath and vigorous scrubbing.

The dressing of boro-salicylic solution is to be permitted to remain until the patient is etherized and brought to the operating-table. In view of the frequency of renal congestion following the administration of an anesthetic, and the necessity for limiting the amount of fluids to be taken by the stomach for the first few hours following the operation, on account of the nausea and vomiting in many cases, the patient should be encouraged at this time to take as much fluid as possible.

Upon the morning of the operation the patient is to have a simple enema; he should also absolutely abstain from food for six hours, and from drink for at least two hours before the operation. Unless some direct indication is present for its employment, no stimulants are to be given at this time, for the reason that they increase the tendency to vomit under the anesthetic.

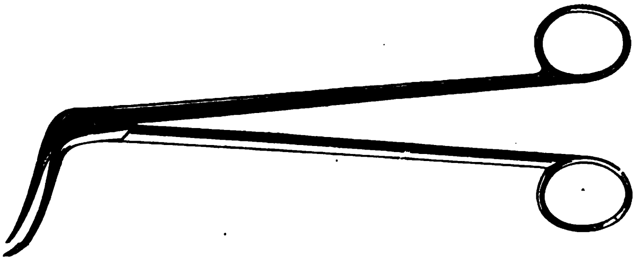
Where the operation must be proceeded with without delay, and there is not sufficient time to properly prepare the patient, cleansing and shaving the abdominal wall just prior to the operation must suffice. It may then be covered with a towel, wrung out of the solution of corrosive sublimate, pending the remainder of the preparation. When the patient is placed upon the table, I have been in the habit, in emergency cases, of applying tincture of iodine over the parts immediately concerned in the operation, as an additional precaution.

The Instruments Required.—In selecting the instruments required it will be useful for the operator to rehearse the operation in his mind, and make out his list of instruments at the same time, in the order in which they are to be used. In this manner he will familiarize himself with the different steps of the procedure, and be more certain to have at hand just what will be required.

For the purposes of the anesthetizer, the following should be provided: A hypodermatic syringe and morphia and atropia tablets, a chloroform-mask and chloroform, an ether-inhaler and ether, a tongue-forceps, and whiskey for hypodermatic use poured out in a small glass; nitrite of amyl, tablets of nitro-glycerin and of strychnia, and a Faradic battery should always be at hand.

Next in order will come the instruments proper. These will include, following the order in which they will be required, two scalpels of medium size, twelve hemostatic forceps, two anatomical or dissecting forceps, scissors, both curved upon the flat and straight, retractors for the abdominal incision, a Keith's ligature-carrier, or Cleveland's modification of the same (Fig. 25), or an aneurism needle; the ligature-crutch for carrying the loop surrounding the appendix well down to its base, where this is not easily accessible (Fig. 26); the thermo-cautery; six long sponge forceps for cleansing the abdominal cavity; full-curved and straight fine round needles for applying the Lembert suture; an Abbe's needle forceps, a most convenient instrument for intestinal work, and large curved needles for closing the abdominal wound. The fingers alone can manage these large needles best, as a rule. I have modified the Hagedorn needle so that it may be grasped by a flat-bladed hemostatic forceps by having the portion at the eye-end twisted a quarter turn upon itself. This does not alter the shape of the opening in the skin which the Hagedorn needle makes, and in which resides the principal advantage in its use (Fig. 27).

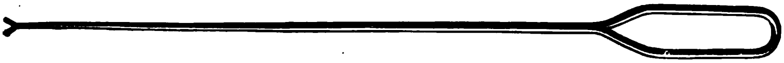
FIG. 25.



Cleveland's ligature carrier.

Ligature material should be of fine silk or catgut. The latter may be sterilized by boiling in alcohol if proper facilities are at hand for accomplishing this. If not, that prepared by immersing the catgut for a few hours, or over night, in equal parts of carbolic acid, glycerin, alcohol and water, and subsequently transferring to alcohol for permanent preservation, is to be preferred. The silk used should be iron-dyed (Brainerd & Armstrong's make), and sterilized by boiling in a five-tenths of one-per-cent. solution of chloride of sodium for ten minutes, and then transferred to a 1–1000 alcoholic solution of mercuric chloride. The sutures should be of

FIG. 26.



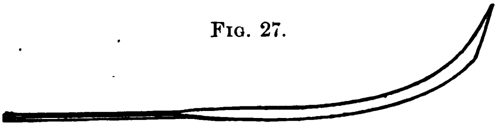
Ligature crutch.

crin-de-Florence or silk-worm gut; this may also be sterilized by boiling in simple water, or the salt solution above mentioned.

Sponges and Dressing-Materials.—These are to be made of cheese-cloth exclusively. Pieces of this material of a single thickness, and eight inches square, when crumpled make sponges or "tüpfe" for common use. A portion of cheese-cloth folded in a manner to make an eight-inch square, and from six to eight thicknesses, makes a laparotomy sponge. A yard square of the cheese-cloth, when crumpled, makes a dressing for the wound; as many of these as required may be used. A "bat" of cotton-batting is used to cover the immediate dressings, two or three broad strips of adhesive plaster to secure the dressing from slipping, and an abdominal binder to cover all, similar to that described in speaking of the preparation of the patient, is to be provided. Two dozen of the eight-inch squares or "tüpfe," a dozen of the laparotomy sponges or compresses, and a dozen of the yard squares should be provided.

The Sterilization of the Instruments.—At the present time aseptic precautionary measures have largely taken the place of antiseptic methods. It is the surgeon's bounden duty to prevent, in so far as in him lies, contamination by means of any article which he brings in contact with the patient. This holds true in cases already septic as well as in those aseptic. No one may know at just what point the fatal germ entered where a lethal exit terminates the case.

FIG. 27.

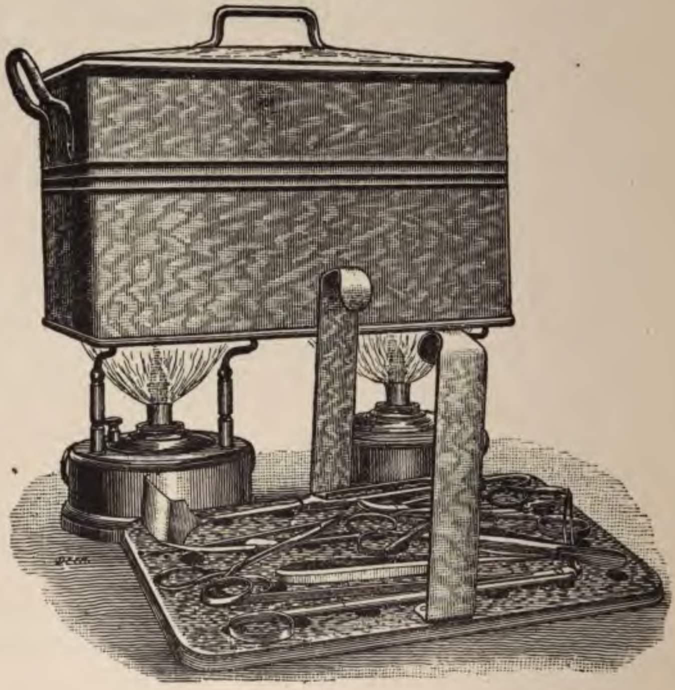


Modified Hagedorn needle.

Special means of accomplishing disinfection of the instruments and dressing-materials by heat are now numerous. These include apparatuses for dry-heat sterilization, and those employed for moist-heat or steam sterilization. The former involves a somewhat cumbersome and expensive apparatus, including double-walled asbestos-covered ovens, with thermometer and thermostat attachments. Even with these precise methods of regulating a certain degree of heat, the edges of cutting instruments are dulled by having their temper drawn. At least an hour's exposure is necessary for the sterilizing process, and even this, it is claimed, should be repeated (fractional sterilization).

Boiling the instrument for five minutes in a one-half of one per cent. solution of alkaline carbonate of soda (common washing soda, a teaspoonful to a quart of water) answers the purpose for all but edged instruments. The edges of the latter are roughened by so long an exposure to the action of the alkali. If these have been well-cleansed previously by scouring, boiling for one minute in the soda solution will be sufficient. A good hand-forged and properly tempered blade will bear this without injury. An asparagus boiler answers a good purpose for boiling the instruments; the movable tray is a great convenience in removing the instruments from the solution (Fig. 28).

Fig. 28.



Asparagus boiler, for sterilizing purposes.

Upon being removed from the boiler the instruments are placed, if the case is such as not to require the employment of antiseptic agents, upon a sterilized towel and covered by another towel. An additional precaution is to place the instruments in a three-per-cent. solution of carbolic acid, in open trays. Ordinary domestic pie-baking dishes answer the purpose. If the surgeon elects to provide himself with special convenience for this class of work, he may procure from the dealers a set of hard-rubber trays made for this purpose. A bowl of sterilized water, or a three-per-cent. carbolic solution, should be placed upon the table beside the instruments to rinse off the latter as they are returned from the operator, and before replacing them in the tray.

The Sterilization of Dressing and Sponge Materials.—This can be accomplished in as simple and entirely satisfactory a manner as the process for the sterilization of instruments just detailed. After the instruments are removed from the boiler and placed in the three-per-cent. carbolic solution, the former is utilized, after emptying it of the washing-soda solution, for the sterilization of the gauze or cheese-cloth material for the tüpfe, dressings, laparotomy sponges, etc. These should be packed in the boiler in such order as will permit of their removal as they are required. Those articles which are to be used last should be placed at the bottom, and so on; unnecessary handling will thus be avoided. The silk is wound upon glass bobbins or spools, and is boiled with the gauze; the silk-worm gut is also boiled in the salt solution.

A six-tenths-per-cent. solution of common salt is now poured over the contents of the boiler. A teaspoonful of the salt to a pint of water is near enough to the strength of the solution mentioned for all practical purposes, and boiling for ten minutes is sufficient for complete sterilization. The silk and silk-worm gut are removed and placed in the carbolic solution; the remainder of the contents of the boiler are removed as they are required in the course of the operation.

Articles to be Steam-Sterilized.—The sterilization of the operating-gowns, linen caps for covering the head, the cotton batting and binder, as well as the rubber aprons, is accomplished by the use of the Arnold's steam-sterilizer, now so commonly used for milk sterilization. The binder, being the last to be used of the articles steam-sterilized, is placed upon a folded towel in the bottom of the sterilizer. Upon this is placed a roll of cotton batting, and over this another towel is placed. The linen caps for covering the head of the operator and the assistants come next in order and then the operating-gowns. A dozen towels are next placed in the sterilizer, then two laparotomy sheets, and finally the water-proof aprons, previously washed in soap and warm water, are placed on top of all.

One-half hour's steam sterilization is required for these articles. The surgeon will do well, therefore, in order to avoid unnecessary delay, to commence his preparation by packing the steam-sterilizer and starting this part of the preliminary work in advance of the rest.

The Disinfection of the Surgeon and his Assistants.—The surgeon and his assistants should make every possible endeavor to secure the most perfect cleanliness in every respect about their own hands, arms, beard, hair, etc., and should exercise a strict conscientiousness in maintaining the same. Those who are to handle instruments, sponges or dressings, and who are to come in contact in any way with the field of operation, should scrub their hands and arms vigorously with green soap and warm water for at least five minutes, after which these parts should be well rubbed with gauze soaked in alcohol, after which they are immersed in a 1–1000 corrosive sublimate solution to which has been added an excess of potassium permanganate until a deep brown stain is obtained. They are then rinsed in 95-per-cent. alcohol. The finger-nails should be trimmed prior to the scrubbing, and especial care given to their cleansing. During the operation there should be conveniently placed a bowl of corrosive sublimate solution in water for rinsing the hands, and another bowl containing a solution of the same in alcohol for rinsing and getting rid of the sticky feeling which results from contact with blood. *After* the operation the stain is removed by means of a saturated solution of oxalic acid.

If the surgeon has been in the habit of carrying on aseptic work, he will have sacrificed his beard to the requirements of absolute and typical technique in this respect. If he wears a beard, he must wash this very thoroughly and disinfect it with a corrosive sublimate solution. In addition to this he will wear a properly-constructed hood, which will cover the beard upon his face as well as the hair upon his head.

The patient is anesthetized upon his own bed, and then carried to the room which has been prepared for the operation. As little of the bed-clothing should be brought with him as possible, and this should be removed and taken out of the operating-room at once. If sufficient time has been available for the purpose of a preliminary cleansing of the parts, these should now be exposed and subjected to a final washing with turpentine, followed by rinsing with alcohol and ether. Scrubbing and shaving after the patient is under the anesthetic is to be avoided when possible. Particular attention is to be paid to the umbilicus. After thorough cleansing this is pencilled in its depths with Whitehead's varnish or Woefler's mixture (a ten-per-cent. mixture of iodoform in compound tincture of benzoin). The field of operation is to be well isolated by the liberal use of sterilized sheets and towels covering the remainder of the patient's body.

The Trendelenburg position is best adapted for the removal of the appendix provided no septic fluid surrounds the latter. In case an encysted sero-purulent deposit or an appendicular abscess is present, this position has the disadvantage of favoring the passage of the pus to the upper portion of the peritoneal cavity. For operations performed during the period of quiescence, as well as during the first few hours of an attack, it is greatly to be preferred.

The flat dorsal position should be first employed in all doubtful cases. If it is found upon reaching the appendix that neither sero-purulent nor purulent material is present, the patient may be brought to the Trendelenburg position for the remainder of the procedure. This may be readily accomplished if a proper table is employed, which permits an easy and rapid change from one position to the other. If a tumor is felt, it is fair to assume that septic fluid is present, and the dorsal position must be used.

The Choice of Operation.

In selecting the site and method of the abdominal incision in operative attacks upon appendicular lesions, two cardinal points must be borne in mind: First, the parts within the abdomen involved in the intended operation should be brought readily within reach. Second, weakening of the wall of the abdomen must be avoided as much as possible by carrying the incision through the latter, whenever practicable, in the direction of the fibres of those structures upon which mainly depend the function of the abdominal wall in resisting the intra-abdominal pressure.

In addition to these there is another point to which it may be necessary to sacrifice all other considerations. I refer to the presence of infectious material about the appendix, which, in addition to the requirements incident to drainage, will demand that the most direct route and easily executed technique only be involved in the operation chosen.

The incision in all cases should be so planned as to include removal of the appendix, either through the abdominal wound as at first made, or by extension of its original limits. This refers likewise to cases of appendicular abscess. An unexpected opportunity may be afforded for the removal of the organ following the evacuation and cleansing of the abscess cavity,—a much desired end when it can be reached without undue risk of infecting the general peritoneal cavity. In order to accomplish this with ease and celerity the technique demands free access to the base of the organ or its point of junction with the cecum. Inasmuch as an incision planned to meet this indication will always be available both for evacuation of the abscess cavity and removal of the organ, the question of the selection of a method of operation to suit the individual case will not turn so much upon the indications or contra-indications for the removal of the appendix as upon the necessity or otherwise for drainage in the case.

If the surgeon were permitted to follow the anatomico-physiologic indications in conducting a lateral abdominal section, bending his whole energies to the conservation of the integrity of the structures of the abdominal wall in connection with the necessity for reaching the appendix with ease and certainty, the choice of operation could be settled without difficulty. Unfortunately, however, the methods of entering the abdominal cavity, which are ideal from this stand-point, offer the least opportunities for carrying out what, in a large number of cases, becomes a most important demand,—namely, the necessity for drainage.

The surgeon must always regret the necessity for drainage which cases operated upon after the infection has passed beyond the appendix itself only too often require. If he, and he alone, were responsible for this requirement in the case, he could not employ a drain without feeling that it was an acknowledgment on his part of an error of judgment in not having operated earlier. For there certainly is a time in every case of appendicitis when an ideal operation can be performed, and the abdominal wound fully closed and drainage dispensed with. But drainage will probably always remain an important part of the operative procedure in a large number of cases of appendicitis, and it will, therefore, be necessary in cases demanding it to select a procedure that will permit of its application, and at the same time inflict as little damage as possible upon the abdominal wall. On the other hand, if the operation follows the commencement of the attack so closely as to insure freedom of the surroundings from infection, or is so remote from the termination of the attack that the infection has disappeared,—in other words, if conditions are present which offer a clean operating-field,—the surgeon, disregarding questions of drainage entirely, will simply consider the question of reaching the appendix with the least possible damage to the abdominal wall at the site of the incision.

The cases which are presented to the surgeon may be divided practically into four classes, as follows:

(1) Those which always require drainage. Cases of appendicular abscess belong in this class.

(2) Those which may or may not require drainage, *but probably will.* In this class are to be placed all cases operated upon after the lapse of twenty-four hours following the attack and before the appearance of a palpable tumor, and hyperacute cases at any period of the attack.

(3) Cases which may or may not require drainage, *but probably will not.* Those included in this class comprise cases operated upon early in an average acute case, say before the lapse of twenty-four hours, in which the surgeon is justified to a reasonable extent, from the symptoms and history, in the hope that the infection has not spread from the appendix, and that therefore with the careful removal of the infected organ the neighborhood may be left in a condition involving no risk in closing the abdominal wound; and, in addition, cases operated upon in the period of quiescence, the infection concerned in former attacks having either disappeared or

ceased to be acutely active (recurrent cases and chronic cases with or without a history of relapses).

(4) Finally, there is a class of cases with which the surgeon has to deal, in which it is impossible to make a diagnosis without opening the peritoneal cavity. Here it is necessary to gain access to three important regions, namely, the right iliac and gall-bladder regions in the male, and these together with the contents of the pelvis in females. Two subdivisions are to be made in this class,—(*a*) males, in whom the diagnosis is most apt to be obscured by lesions other than appendicitis in the ileo-cecal region, and lesions *above* the region,—*i.e.*, in the upper and middle abdominal triangles (see Frontispiece); and (*b*) females, in whom, beside the conditions present in the male, additional sources of diagnostic error reside in the possibilities of diseases of the uterine adnexa occurring in conjunction with or simulating appendicitis.

Therefore the surgeon, in selecting the particular procedure best adapted to the individual case from the standpoint of drainage, will also take into account the possibilities of being compelled to explore regions beyond that of the appendix. If the patient be a male, and there is any doubt of the accuracy of the diagnosis, he must be prepared to explore the upper portion of the abdominal cavity particularly, in addition to the parts about the appendix; and if a female, in a doubtful case he must be prepared to explore the pelvic organs, and perhaps the upper portion of the abdominal cavity as well. In view of the frequency, in my experience, of the association of right-sided adnexal lesions of a more or less chronic character with appendicitis, I make it a rule to explore the contents of the pelvic cavity before closing the abdomen in all appendicitis operations in females in which this can be done without risk of spreading infection.

Practically, three operative methods are available, each of which possess decided and distinct features of its own, rendering it applicable to one or more of the classes of cases mentioned. These are designated as follows:

(1) The operation by the oblique incision.

(2) The intermuscular methods.

(3) The operation by the vertical incision through the sheath of the rectus muscle.

The first and last in this list will permit of either direct drainage or immediate closure of the wound. That either the one or the other is not deemed applicable to all classes of cases, as would seem to be the case at first glance, is due to the fact that, by their employment, more or less damage is inflicted upon the muscular wall of the abdomen, as well as important nerve structures divided, this latter resulting in still further weakening the abdominal wall. The second is usually selected when neither drainage nor extensive exploration is necessary. Should conditions unexpectedly develop demanding drainage after the abdomen has been opened by one of the methods not adapted for purposes of drainage, provision is to be made for the latter by a small supplementary incision favorably placed in the manner to be referred to later on.

Referring now to the four classes of cases mentioned as coming under the surgeon's care for operation, it may be briefly stated that those of the first class, which always require drainage, as well as those of the second, which may or may not, but probably will require drainage, should, in the main, and particularly at the hands of those not well-versed in abdominal section, be submitted to the operation through the right semilunaris by the oblique incision. Those in the third class, in which drainage will probably not be required, should be operated upon by one of the intermuscular methods. If the patient is a female, in order to explore the pelvis and investigate its contents, and perhaps remove a diseased tube and ovary, the intermuscular operation, in which the transverse incision is carried behind the rectus muscle, will be found the most available. Further, in view of the desirability, upon every possible occasion, of avoiding division and substituting therefor separation in the line of their fibres of the muscular structures of the abdominal wall, the experienced operator, in the presence of an accurately defined inflammatory process limited to the ileo-cecal region, may employ this intermuscular method with advantage.

Finally, in the class of cases in which the diagnosis is obscure and the operation must be, to a large extent, an exploratory one, the vertical incision, which opens the sheath of the rectus muscle and permits of extension of either of its extremities in the course of the investigation, will be the operation of choice, particularly in males. In females the intermuscular method last mentioned will answer for exploring the pelvis, and may be employed with advantage, providing there is no reason to anticipate the necessity for drainage of parts beyond the immediate neighborhood of the appendix.

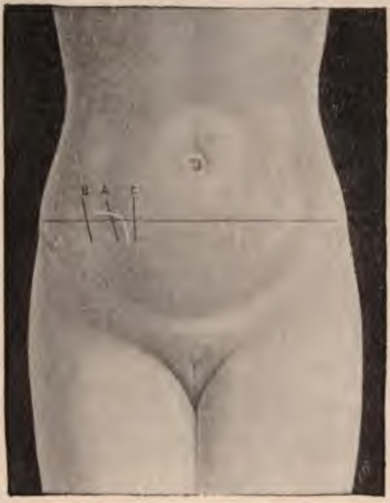
Certain cases may require a lumbar incision; those, for instance, which have resulted in a lumbar phlegmon. Here the indications are clear: The area of suppuration should be freely incised, and access afforded to its deepest point.

In the case of a deep pelvic abscess occurring in the female, and in which it is reasonably certain that the intervening structures are so matted together by the inflammatory process as to afford a reasonable guarantee against connective-tissue extravasation or infection, or both, by means of the contents of the abscess, the vaginal route may be chosen for the evacuation of the pus preliminary to abdominal section for the removal of the appendix, the latter being done either at the same sitting or by a subsequent operation.

In those instances in which the presence of a true appendicular abscess can be made out, the purulent collection having taken place in the post-peritoneal connective tissue, and bounded anteriorly by the transversalis fascia and posteriorly by the iliac fascia, the abscess cavity may be reached by a horizontal or an oblique incision placed to the outer side of the epigastric artery. The skin, superficial fascia, aponeurosis of the external oblique, the transversalis muscle and transversalis fascia are successively divided. By this means the focus of suppuration is reached without incising the peritoneum.

The Operation by the Oblique Incision.—This incision is so planned as to give ready access to the linea semilunaris upon the right side, through which it is designed to enter the abdomen (A, Fig. 29). Such is the intention, but owing to the difficulty of exactly fixing the limits of this landmark beforehand, the sheath of the rectus muscle is frequently opened and the abdomen entered, not through the linea semilunaris, but behind or at the outer margin of the rectus. There is no objection to this, provided care is taken to avoid the deep epigastric artery and veins (Fig. 18), and particular attention is paid in suturing the abdominal opening to secure both the anterior and posterior lamellæ of the sheath of the rectus in the suture. Should the typical incision through the linea semilunaris be carried out, however, it will not infrequently be

FIG. 29.

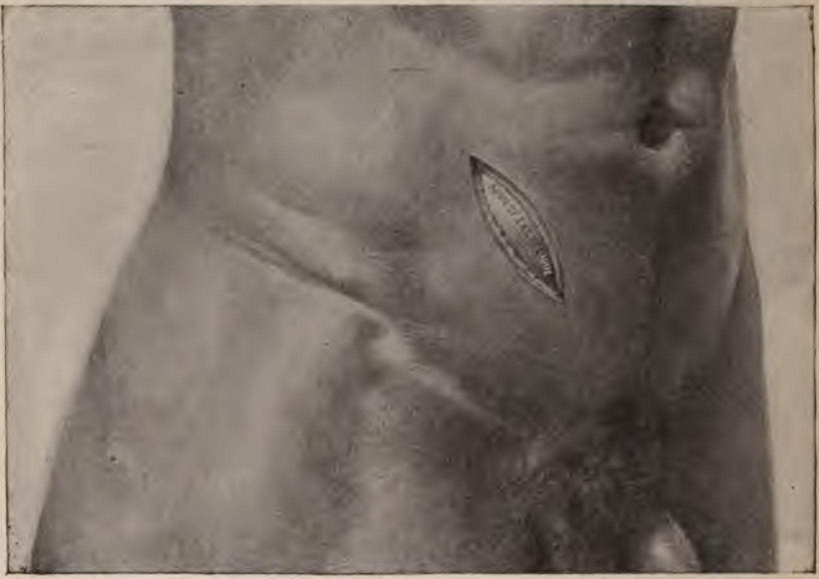


Lines of incision for operations on the appendix; "A," the oblique incision; "B," the incision for McBurney's intermuscular method; "C," the vertical incision. The white curved line represents the line of incision for the author's intermuscular method

found necessary to extend the cut in an upward direction, incising more or less of the muscular portion of the internal oblique in so doing, in order to gain sufficient room for the purposes of the operation.

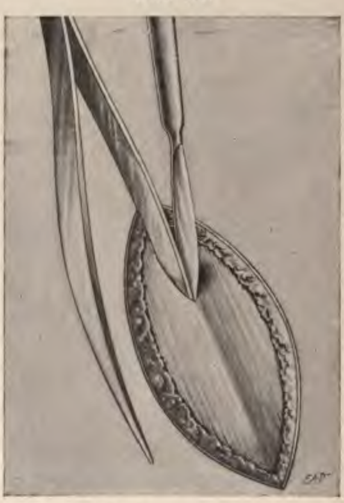
The incision is commenced about an inch above a line drawn from the umbilicus to the anterior superior spinous process of the ilium, and is carried downward and inward for from two and one-half to three inches. The middle of the line of incision should rest on a point corresponding to the intersection of the vertical with the transverse lines shown in Fig. 19. The skin, fat, superficial and deep fascia are divided, and the aponeurosis of the external oblique cleared (Fig. 30). This is incised by a clean cut in the direction of its fibres, one of the blades of the anatomical forceps being employed as a guide, the knife blade following the flat side of the forceps blade (Fig. 31).

FIG. 30.



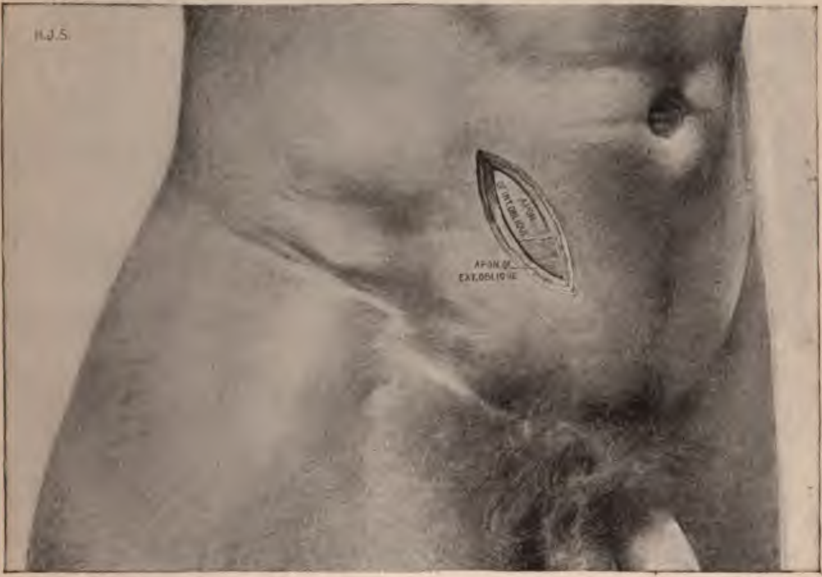
The aponeurosis of the external oblique as it appears in the oblique incision.

FIG. 31.



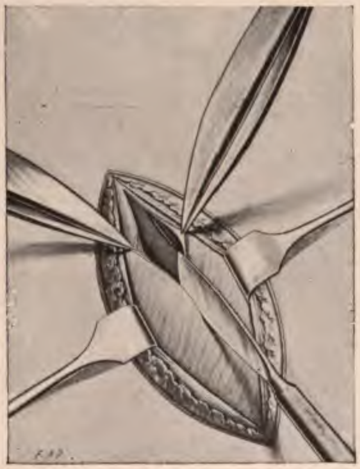
Incision of the aponeurosis of the external oblique, showing also the manner of using one of the blades of the anatomical forceps as a guide.

FIG. 32.



The internal oblique as it appears in the oblique incision

FIG. 33.



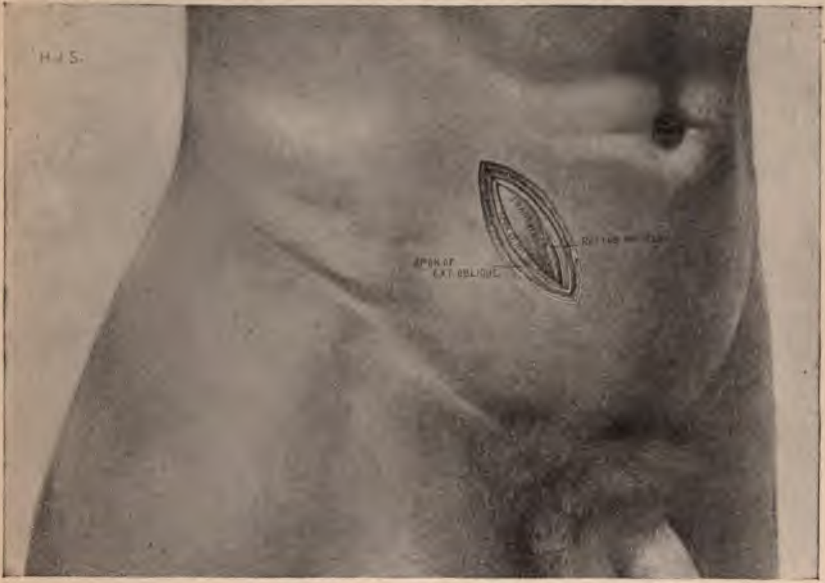
Incision of the internal oblique and sheath of rectus muscle.

Retractors are applied to the incised edges of the aponeurosis of the external oblique and the aponeurosis of the internal oblique cleared for the next incision (Fig. 32). The last-named structure is grasped by anatomical forceps (Fig. 33), one in the hands of the operator and the other held by the first assistant, who stands opposite. The incision through the fibres of the aponeurosis of the internal oblique is carried the length of the skin incision. Should the sheath of the rectus be opened in this incision two layers of the internal oblique will be identified, one passing in front and the other behind the muscle. Retracting now the cut edges of the internal oblique and exposing the transversalis (Fig. 33), and grasping, as before, with two pairs of forceps, the transversalis tendon and fascia are grasped as one layer and a slight incision made to expose the peritoneum. The branch of the twelfth intercostal artery, which accompanies the corresponding nerve, is sometimes encountered at this point and may require a ligature.

As the incision deepens over the seat of the disease, if the latter is ventrally placed and advanced to the stage of suppuration, some edema of the abdominal wall, with or without matting together of its separate structures, will be observed. Where no suppuration is present, or where it is deeply placed dorsally or in the pelvis, this will not be seen. When present it will serve as a guide to adhesions between the peri-appendicular structures and the abdominal wall, and will sometimes enable the operator to reach the interior of a sero-purulent or purulent collection without invading the peritoneal cavity at this stage of the operation. The peritoneum is recognized by its very thin character and by the upward and downward movements of the intestines beneath, if the visceral and parietal layers of the peritoneum are not attached to each other.

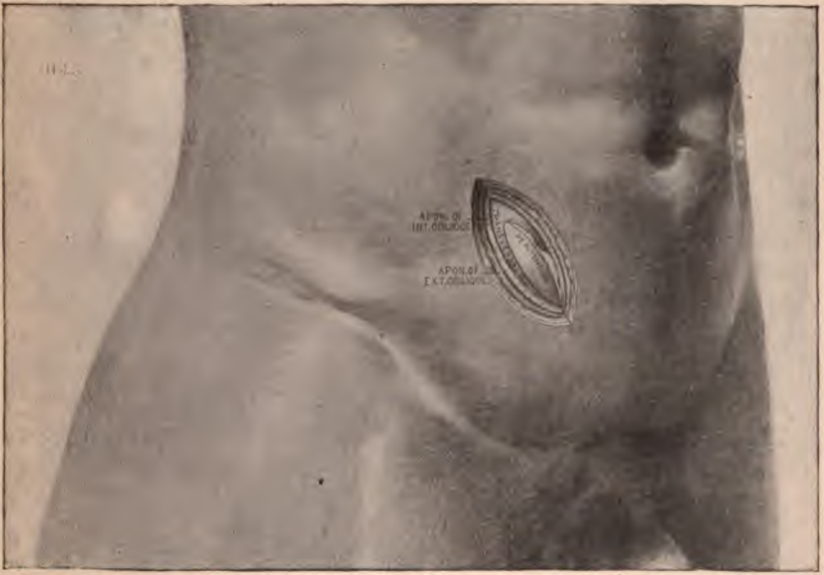
The peritoneum is now grasped by the anatomical forceps in the same manner as were the other layers, and the presenting fold incised. In thus grasping the peritoneum to incise it, care should be exercised to lift it as far anteriorly as possible, in order to avoid injury to the omentum or intestine beneath when the cavity of the peritoneum is finally invaded. Of course if adhesions exist at this point, it will not be prudent, even if it were possible, to so lift it. The peritoneum being opened, the index finger is introduced

FIG. 34.



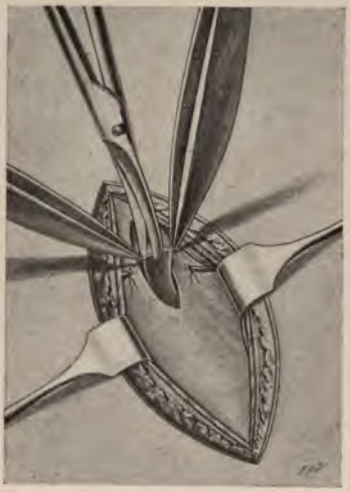
The transversalis as it appears in the oblique incision.

FIG. 35.



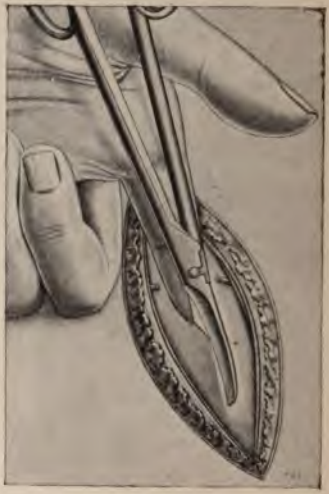
The peritoneum as it appears in the oblique incision through the opening, and upon this, as a guide, and to guard against injury to the intestine or omentum, the incision is extended in either direction to the required extent, the transversalis fascia and peritoneum being divided as one layer (Fig. 37).

FIG. 36.



The peritoneum drawn through the opening in the transversalis.

FIG. 37.



The incision in the peritoneum.

If no adhesions exist ventrally, the operator proceeds at once to expose the cecum by making any necessary addition to his original cut.

The Operation by Intermuscular Methods.—The object in these methods is to enter the abdominal cavity through the musculo-aponeurotic structures of the abdominal wall by a separation of these structures effected in the direction of their fibres. In the original intermuscular operation, introduced by McBurney,[1] the skin incision is made parallel to the oblique incision just described, and somewhat to the outer side of the site of the appendix (Fig. 29). The section of the external oblique corresponds to that of the skin, and the fibres of the internal oblique muscle are separated in their normal direction. While this incision gives access to the appendix when the latter lies to the outer side of the cecum and points in an upward direction, when the organ lies in any one of the other positions in which it is frequently found, particularly behind the cecum, sufficient room is not obtained for the necessary intra-abdominal manipulation. When adhesions are encountered as the result of former attacks, or the appendix is post-peritoneally situated, the difficulties arising from want of working space are greatly increased. In addition to this, this method does not permit of ready exploratory and operative access to the pelvic organs in the female. Finally, the fact that the skin incision is placed in direct relation with the incision in the aponeurosis of the external oblique favors infection of the latter in case the healing process is complicated with stitch abscesses at the point where the vital resistance of this important structure of the abdominal wall is lessened.

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[1] Annals of Surgery, Vol. xx, p. 38.

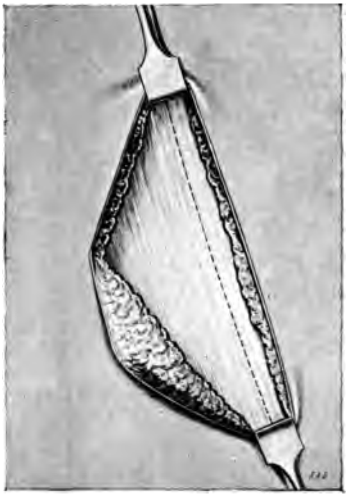
In the intermuscular method devised by myself the operation is based upon the principle just mentioned,—namely, of gaining access to the abdominal cavity by means of separation of the fibres of its muscular walls in their normal direction rather than by cutting across these, thereby insuring greater stability of the wall upon the completion of the healing process. It differs from the originally devised intermuscular operation in that it gives readier access to the contents of the ileo-cecal and pelvic regions, as well as a larger working space, without corresponding increase in the size of the external incision. This increased working space is obtained by carrying the inner portion of the transverse incision behind the rectus muscle, extending it, if necessary, almost, if not quite, to the median line. When sutured, this latter portion of the line of union is supported by the overlying rectus muscle. One half of the skin incision is placed nearly at right angles to the incision in the aponeurosis of the external oblique, while the other half is well to the inner side of the latter. In this manner the "break-joint" feature of the intermuscular method is more completely carried out, and the dangers of infection of the suture line of the aponeurosis of the external oblique are diminished.

The Skin Incision.—The incision commences at the upper rounded prominence of the anterior superior process of the ilium, is carried horizontally to the outer edge of the rectus abdominis muscle, from which point it is curved downward and extended parallel with the edge of the rectus for a distance of about two and a half inches (Fig. 29).

The skin, fat and fascia are divided and the triangular-shaped flap with rounded corner dissected and reflected downward and outward, exposing the aponeurosis of the external oblique.

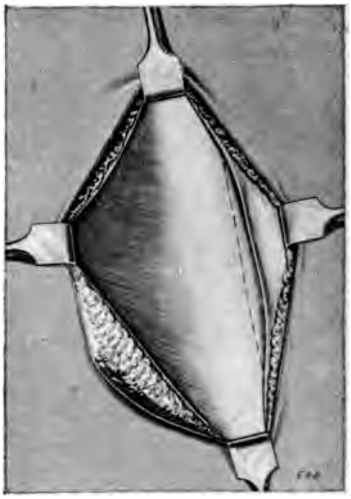
A retractor is applied at the lower angle of the wound and another at the middle of the horizontal incision. Traction upon these in the direction of the course taken by the external oblique exposes the latter for a distance of three or more inches if necessary (Fig. 38). This structure is divided in the direction of its fibres to the extent of its exposed portion, its cut edges retracted (Fig. 39), and the sheath of the rectus exposed and likewise opened. The rectus muscle and the underlying deep epigastric artery and veins are now retracted strongly toward the median line, the outer edge of the incised aponeurosis being retracted in the

FIG. 38.



The author's intermuscular method. The aponeurosis of the external oblique exposed. The dotted line shows the place of the incision in this structure.

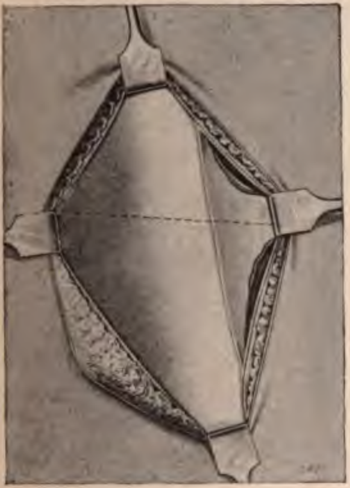
FIG. 39.



The author's intermuscular method. Dotted line showing the site of the incision into the sheath of the rectus muscle opposite direction. A space of four inches or more in its transverse diameter may be thus exposed.

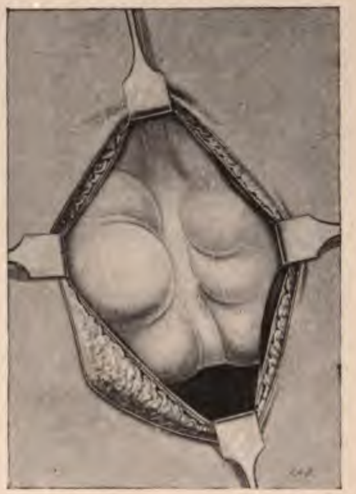
With the rectus well displaced towards the median line (Fig. 40), care being taken to retract the deep epigastric artery and veins as well, and the outer edge of the incised external oblique aponeurosis retracted in an outward direction, the following parts are exposed: In the outer two-thirds of the space between the retractors is to be seen the muscular portion of the internal oblique, this terminating in the aponeurotic portion of this muscle at the point where the latter divides to enclose the rectus (the linea semilunaris); the inner third includes that portion of the exposed space left by the inward displacement of the rectus muscle, and is occupied by the posterior lamella of the sheath of the latter. In this space the transverse incision is to be made. For the purposes of this operation the remaining structures of the abdominal wall may be considered as one layer, and the transverse incision carried directly through these in the direction of the fibres of the internal oblique and transversalis into the peritoneal cavity. The incision is com-

Fig. 40.



The author's intermuscular method. The site of the transverse incision.

Fig. 41.



The author's intermuscular method. The opening in the abdomen.

menced at the inner end of the space beneath the rectus muscle and access gained to the cavity of the peritoneum at this point first; after which, with the finger as a guide, the section is completed. Retraction of the edges of the transverse incision will be found to give free and ready access to the entire cecum (Fig. 41).

The advantages claimed for this method of operating are as follows:

1. Ready access is gained to the appendicular region, and ample room secured for all necessary manipulation in the class of cases for which it is designed.

2. Weakening of the abdominal wall and the liability to surgical hernia are reduced to the minimum by (a) incising the important musculo-aponeurotic structures in such a manner as to secure immediate, firm and permanent union; (b) avoiding injury to the vascular and nerve supply of the parts involved in the incisions; and (c) by reason of the relations which the lines of incision bear to each other when sutured.

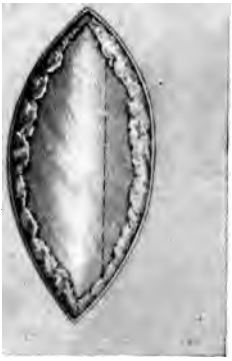
The Operation by the Vertical Incision.—In order to gain access to the right half of the abdomen and pelvis for exploratory purposes, the vertical incision just within the outer border of the rectus muscle is employed. In seeking for confirmation of the suspicion of appendicitis in a given case, the surgeon will so place the incision as to first reach the appendix; afterward extending, if necessary, the upper or lower angle as required by the exigencies of the case.

If, as frequently happens, the outer border of the rectus abdominis muscle cannot be made out with certainty, the line of the incision may be placed at one-third of the distance measured from the median line to the prominence of the anterior superior spinous process of the ilium, with its centre resting upon a point directly opposite the latter (C, Fig. 29). A two-and-a-half to three-inch incision so placed will give ready access to the region of the appendix and an extension of the incision in an upward or downward direction will enable the operator to reach in turn the region of the gall-bladder and the contents of the pelvis.

The skin, fat and fascia being divided and retracted, the aponeurosis of the external oblique is brought into view where it blends with the anterior lamella of the sheath of the rectus muscle

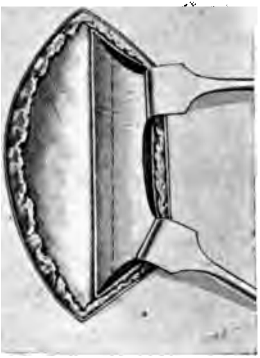
(Fig. 42). The aponeurosis and sheath of the muscle are divided by the same cut and the edges of this incision retracted, the retractor upon the side toward the median line including the rectus muscle. Should the latter not retract easily, it should be loosened from the posterior lamella of its sheath by the handle of the scalpel. This blunt dissection will enable the operator to identify the epigastric vessels. These are to be included in the grasp of the retractor and kept out of harm's way (Fig. 43).

FIG. 42.



The vertical incision. The aponeurosis of the external oblique where it blends with the anterior lamella of the sheath of the rectus muscle. The dotted line shows the place for the incision to open the sheath of the rectus muscle.

FIG. 43.



The vertical incision. The rectus muscle drawn toward the median line. The dotted line shows the place for the incision to enter the abdominal cavity.

The abdomen is now entered through the outer edges of the space exposed by the retraction of the rectus muscle. The structures remaining to be divided are the posterior lamella of the sheath of the rectus (the aponeurosis of the internal oblique), the tendinous expansion of the transversalis muscle, the transversalis fascia and the peritoneum. The first three are so blended as to constitute, surgically, but one layer, and may be divided as such. The peritoneum should be raised and incised separately.

The Intra-Abdominal Technique.

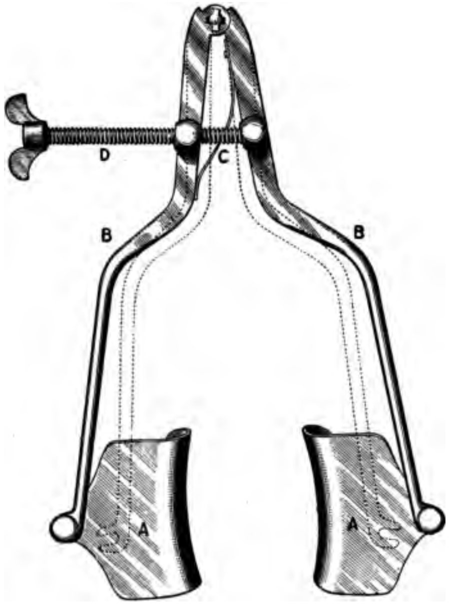
Isolation of the Intra-Abdominal Operating-Field.—Upon entering the abdominal cavity in an operation for appendicitis, the surgeon's first care, after satisfying himself of the general condition of affairs about the appendix, will be to isolate the field of the further steps of the operation by gauze compresses, so disposed as to protect parts not already the seat of infection. A laparotomy sponge or square of gauze made up of several thicknesses is placed in the wound at once to prevent the escape of intestine. With the latter held in restraint a smooth, flat retractor is used to lift the inner edge of the abdominal opening well forward, and in the space thus gained a laparotomy sponge or gauze compress or two is gently pushed. The upper and lower angles of the wound are dealt with in a similar manner, the gauze compresses having tapes sewed to one of their corners to help identify their positions.

While these precautions are undoubtedly unnecessary in some cases, such, for instance, as in operations during the period of quiescence, and perhaps also when the infection is confined to the appendix, yet experience has taught me that it is a wise precaution to take in all cases. The small intestine is prevented from encroaching upon the field of operation by this maneuvre, and the spreading about of infectious material unexpectedly encountered provided against.

The question of retraction of the edges of the abdominal opening is an important one. A faultily-shaped retractor, even in the hands of a skilled assistant, is always a menace to the abdominal contents, besides being frequently inefficient. The same may be said of any retractor, however well adapted to the purpose, in the hands of an untrained assistant. Under the most favorable circumstances, these instruments, as commonly furnished, are a source of anxiety to the operator. Retraction performed by the fingers of an intelligent assistant offers less risk of mechanical injury, but is objectionable, first, because this method introduces additional possibilities of infection, and, second, because the fingers themselves are frequently in the way. I have of late derived considerable satisfaction from the employment of the self-retaining retractor shown in Figure 44.

Should a gush of pus occur, this must be gently but rapidly gathered up on bunches of gauze previously prepared and fastened in sponge-holders or long forceps ("stick sponges"). Should this have a strong fecal odor the stick sponges should be wrung out of a 1-3000 corrosive sublimate solution. A sudden overflow of this highly infectious material upon the gauze compresses should at once be followed by wetting those in situ with the sublimate solution. By rapid wipings the abscess cavity is finally cleansed.

FIG. 44.



Self-retaining retractor. *A*, removable blades; *B*, spreading frame; *C*, spring; *D*, double-pitched spreading and retaining-screw.

Some operators at this stage pour a quantity of peroxide of hydrogen into the septic area, afterwards cleansing the latter of the frothy mixture of this agent and the organic fluids present. The soiled isolating compresses are now replaced by fresh ones.

The Search for the Appendix.—The vermiform appendix is now sought for. If this does not come readily into view, or within reach of the operator, search for its site may be further facilitated by identifying the location of the longitudinal muscular bands, each about half an inch in width, upon the cecal wall, which commence at the attachment of the appendix to the cecum. The ventral band, the largest of the three, will usually come into view, unless shut off by adhesions; the dorsal band is placed along the attached border of the intestine. The identification of either of these bands will serve as a guide to the appendix. The third or lateral band is placed upon the left or inner side of the ascending colon, and if adhesions are present, will not be available in the search.

As the adhesions are parted the appendix is identified. This, in the average acute case operated upon early, will be found to be of a somewhat solid consistency, feeling not unlike a slightly flexed little finger. It is to be carefully freed from its surroundings by the finger of the operator, very much in the manner in which the Fallopian tube is isolated in the operation for pyosalpinx.

In the attempt to isolate the appendix the surgeon must not lose sight of the fact that he may do more harm than good if the organ is so placed as to form a portion of the protecting wall of adhesions; particularly if its position prove to be upward and inward, inward or downward and inward. On the other hand, its isolation and removal from the positions downward, downward and outward, outward, upward and outward, and upward will generally be found practicable and safe. If symptoms of intestinal obstruction have been present in the case, it will be best, even with the additional risk, to break up all adhesions with the view of relieving the obstruction, first being assured that thorough disinfection of the primary focus of sepsis has been accomplished.

The Disposition of the Appendix.—The manner of dealing with the appendix will vary with the character of the case. In some instances its condition will not admit of any choice. Simple ligature, by means of chromicized catgut at its base, or as near thereto as possible, the mesentery being included in a separate ligature whenever practicable, and amputation of the organ, the mucous membrane being destroyed by means of the thermo-cautery or fuming nitric acid, is deemed quite sufficient by some surgeons. Indeed, it happens only too frequently that the exigencies of the case will only permit of this method, as in cases in which abscess or a sero-purulent fluid is present, and it is found impossible to gain room for the application of a typical procedure without running the risk of breaking down limiting adhesions. The wall of the appendix, if in a gangrenous condition, will sometimes scarcely hold a ligature, much less permit of the application of sutures in closing over the stump in some of the methods proposed. Even the adjoining wall of the cecum itself is frequently softened by inflammatory processes, and will not hold a suture.[1] Again, the patient's condition will not admit of the delay necessary in these niceties of technique in many of the cases which fall into the surgeon's hands.

The meso-appendix is first ligated and divided, and then separated from the appendix. The manner of dealing with the appendix itself will vary with the conditions existing. Under some circumstances the method of simple ligature with silk or catgut, and cauterization of the stump left after excision with carbolic or nitric acid or with the thermo-cautery must suffice. This, the technique originally employed, has been improved upon by attempts to strengthen the weak point in the cecal wall which this method involves in various ways: first, by laying the stump in a fold of the cecal wall and there securing it by a few Lembert sutures; second, by dissecting back a cuff-shaped flap of peritoneum, ligating the mucous and muscular coats with catgut, excising the appendix, and then replacing the cuff of peritoneum and suturing it, finally burying the stump in a furrow in the cecal wall and suturing the stump of the meso-appendix over the site of the appendix. I have employed the device of Professor Dawbarn in a number of instances. This consists of passing a purse-string suture beyond the base of the appendix upon the cecal wall, and inversion of the half-inch stump of the organ after amputation of the remainder. Professor Dawbarn advises dilatation of the stump left, in order to facilitate the inversion, by means of a slender forceps introduced into its lumen. The inversion is accomplished by grasping the end of the stump with mouse-toothed forceps, and forcing it into the cavity of the cecum, "turning it outside in," so to speak. The purse-string suture is tightened as the invaginating forceps are removed, the stump being prevented from returning with the forceps by a probe held between the blades of the latter. Stricture of the base of the organ and excessive rigidity of an inflamed and thickened appendix will sometimes prevent the inversion of the stump.[1]

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[1] Fortunately, the latter frequently have the effect of obliterating the appendiculo-cecal orifice, and fecal fistula does not follow a failure to apply a ligature at the base of the appendix, or sutures at the site of a sloughing away of the organ close to the cecal wall, as frequently as would be expected.

Typical Excision of the Appendix.—When the conditions will permit of it, *typical excision* of the appendix is the ideal procedure. This is based upon Professor Dawbarn's ingenious device, and is carried out in a similar manner with this difference: the entire organ is excised and the edges of the opening in the cecal wall are invaginated, the opening itself being secured by the purse-string suture.[2] I have employed the method in a large number of cases and with the greatest satisfaction. The technique includes, in addition to the removal of the entire organ, first, measures to prevent infection of the surroundings from contact with the contents of the cecum and of the appendix itself; second, provision against hemorrhage from the point of section; and third, accurate closure of the opening in the wall of the cecum. The different steps of the procedure are as follows:

(1) A ligature is passed through the base of the meso-appendix as near as possible to the body of the organ, tied tightly about the mesentery, and the latter severed and separated from the appendix (Fig. 45).

(2) A purse-string suture of catgut or silk is passed on the cecal wall, including the serous and muscular coats only, from a quarter to three-eighths of an inch from the junction of the appendix with the bowel (Fig. 46). In placing this suture attention should be paid to the following points: First, the first stitch should include both edges of the peritoneum left by stripping back the meso-appendix from the base of the appendix, the stitch being carried back and passed through this a second time. The effect of this is to secure these two edges in such a manner as to draw them

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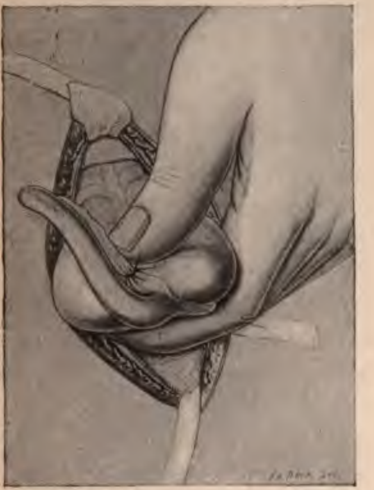
[1] The method of inversion of the entire appendix, even if this were possible in inflammatory conditions of the organ, is to be mentioned only to be unqualifiedly and unreservedly condemned. It is at best an unsafe and highly unsurgical procedure.

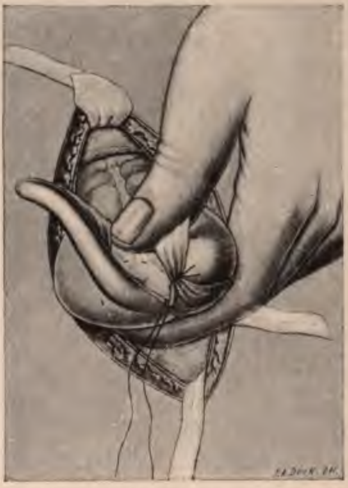
[2] The purse-string suture has been found, upon the basis of experiments performed upon animals, to bear between two and three times as much pressure exerted from within the gut as the Lembert suture (Quervain, Centralblatt für Chirurgie, 1899, xxvii, 753–757). This suture possesses the additional advantage of diminishing the risks of peritoneal adhesions by lessening the area of mechanically disturbed serous surface presented.

FIG. 45.



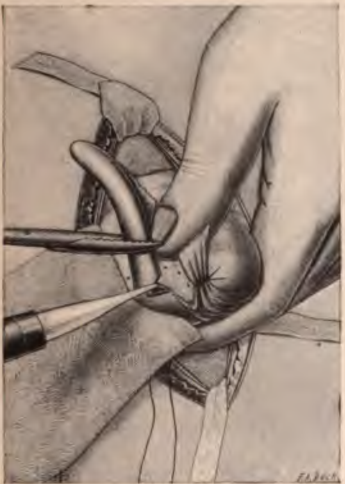
The cecum turned upward and forward, and brought outside of the abdominal cavity and resting upon a gauze compress. The meso-appendix ligated.

FIG. 46.



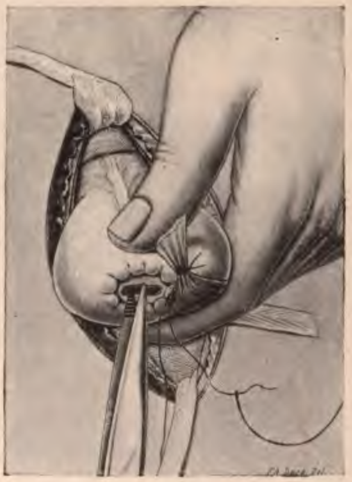
The meso-appendix divided and detached from the appendix. The purse-string suture applied.

FIG. 47.



Amputation of the appendix by means of the thermo-cautery. A square of gauze is so placed as to protect the parts from the heat of the cautery.

FIG. 48.

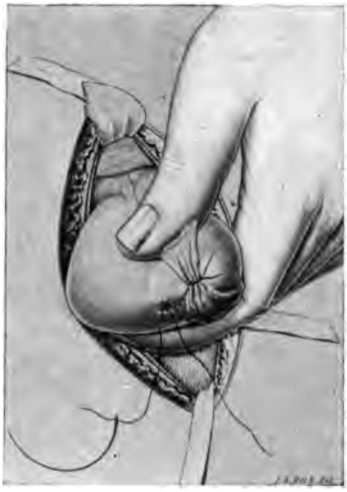


Inversion of the edges of the opening in the cecal wall at the site of the amputated appendix.

together when the stitch is tightened. Second, the portion of the purse-string suture which passes beneath the serosa should be at least double that which is exposed; the less the suture is exposed the greater amount of serous surface becomes available for approximation when the suture is tightened.

(3) The appendix is grasped with forceps near its base and drawn forward and amputated close to the bowel wall with the thermo-cautery (Fig. 47). The section is made slowly, in order to guard against hemorrhage at the point of section, and at the same time to seal the opening in the cecal wall by the charring effects of the cautery point. Following the removal of the organ, the stump, which is really a portion of the cecal wall, is finally and repeatedly touched with the thermo-cautery.

FIG. 49.



The serous surfaces of the cecal wall at the site of the amputated appendix, approximated by tightening the purse-string suture.

(4) The portion of the cecal wall included within the purse-string suture is inverted into the cecum by means of thumb-forceps in the hands of an assistant, as the suture is drawn upon (Fig. 48). The suture is now tightened, thus drawing in close apposition the serous surfaces of the bowel beyond the cut edges, and effectually closing the opening (Fig. 49).

(5) The stump of the meso-appendix is placed over the depression left by the inversion of the cecal wall, where it is secured by tying over it the ends of the purse-string suture. This last step serves the double purpose of placing the raw surface in such a position as to prevent it from forming adhesions to the adjacent coils of intestine and causing intestinal obstruction, and of affording additional support to the weakened cecal wall from which the appendix has been removed.

In the absence of the thermo-cautery, the following method of preventing the escape of the contents of the cecum is to be employed. The appendix is grasped and drawn forward so as to put both it and the cecal wall, to which it is attached, upon the stretch. In doing this the portion of the latter surrounding the base of the organ bulges forward, forming a well-marked diverticulum-like projection. A temporary ligature is now thrown about the portion which thus bulges forward; the ligature is either twisted or tied in a " soft" knot, *i.e.*, the second half or low portion of a single bow-knot, the first portion of the same being omitted. If twisted, the ligature is prevented from untwisting by being grasped with a forceps. The appendix is now amputated with the scissors or knife, the resulting opening in the cecum being guarded by the provisional ligature. Inversion of the cecal wall is accomplished in the same manner as after amputation with the thermo-cautery, and the purse-string suture drawn taut. The "soft" or half bow-knot of the provisional ligature is now released by drawing upon the proper end (the end to be drawn upon being left longer than the other in tying) and the ligature drawn out of the puckered depression produced by drawing up the purse-string suture. The tying of the latter is now completed, and the stump of the meso-appendix sutured over the dimpled depression, as before described.

A deeply congested and even purplish-looking area is sometimes present upon the cecal wall where a gangrenous state of the gut is either already in existence or threatening (gangrenous typhlitis). This should be included in a separate purse-string suture as a precaution against perforation (Dawbarn). This condition of the bowel wall likewise constitutes an indication for drainage.

The Manner of Dealing with Diffuse Septic Peritonitis as Revealed by the Operation.—Should diffuse septic peritonitis be encountered, the primary focus of infection should first be thoroughly cleansed, after first walling this off as much as possible from the remainder of the peritoneal cavity, by flushing this with equal parts of peroxide of hydrogen solution and a saturated solution of bicarbonate of soda. The resulting frothy compound which flows from the depths of the focus is then to be washed away with a warm decinormal saline solution. The neighboring coils of intestine are now drawn out of the wound, carefully cleansed of all fibrino-plastic material, washed with the saline solution, and returned. No force should be used in this part of the technique. If the patches are not easily removed, they should be permitted to remain. Above all things they should not be removed by "scouring" with gauze, as has been advised by some surgeons. Ordinarily they will be found to be quite easy of removal by simply lifting them with forceps. Complete eventration of the small and a portion of the large intestine may be done, when necessary, if care is taken to protect these from injury and cooling. The intestines should be allowed to rest easily upon the abdominal wall, and without dragging upon their mesenteric attachments, and covered with compresses or soft towels, the latter being kept warm by occasionally pouring over them the decinormal saline solution at 110° Fahrenheit.

With the intestines removed from the peritoneal cavity, the latter may now be thoroughly flushed out with large quantities of the saline solution heated to at least 110° Fahrenheit, poured from a pitcher or other suitable vessel. Gallons of this should be used, and care taken that it reaches all parts of the abdominal and pelvic cavities. The latter are now dried out with gauze compresses, after which the intestines are returned and drainage is provided for. Particular attention should be paid in this connection to the necessity for placing the patient with the head and trunk elevated, with the view of facilitating the passage of fluids from the abdomen into the pelvic cavity (see treatment of diffuse septic peritonitis).

Drainage.

Indications.—The indications for drainage in operative attacks upon the appendix are the same as in abdominal section for other lesions. The presence of infection beyond the limits of the portion removed constitutes the positive indication for drainage of one sort or another in the case in hand. The thorough cleansing of an abscess cavity completely walled off from the peritoneal cavity in the manner heretofore described, the infection having been entirely confined within the limits of a mass of inflammatory material thrown out about the appendix itself, is sometimes a temptation to the surgeon to close the abdominal wound without drainage. Although isolated instances of uninterrupted recovery after this plan has been followed occur, yet the surgeon who does a good deal of work in this line will find in the long run that the safer course is to follow the rule here laid down.

Methods of Drainage.—In instituting drainage from a cleansed appendicular abscess cavity provision need only be made for the exit of serum, as from the general peritoneal cavity. This will be easily accomplished by means of the Mikulicz wick-drains, strips of iodoform gauze, or silk pongee (McCosh). Strands of lamp-wicking gathered loosely in a bundle and enveloped in a covering of perforated oil-silk protective to facilitate withdrawal are very useful. Iodoform gauze drainage strips should be folded in such a manner as to turn in their raw edges to prevent fraying.

The presence of opaque serum in the general cavity of the peritoneum without diffuse septic peritonitis will call for the use of either wicking or gauze drains. These should be passed to the bottom of the pelvic cavity, since, in the elevated head-and-trunk position which should be insisted upon as a part of the after-treatment, the fluids naturally gravitate to this point. In the presence of a diffuse septic peritonitis, after dealing with the conditions present in the manner already described, drainage-strips may be led from remote portions of the peritoneal cavity to the operation wound, in addition to the pelvic drains I sometimes employ combined tube and gauze or wicking drains (glass drainage-tubes enclosing gauze or wicking) in the case of women with deep pelvic infection from appendicular lesions, an opening being made in the posterior or *cul-de-sac* of Douglas, and the glass drainage-tube carried into the vagina. Wherever a glass drain is employed care should be taken that it is "dressed" separately; that is to say, that it should project through and beyond the dressing applied to the surface, in order that bandages applied to retain the latter in place do not make pressure upon the tube. I have known fecal fistula to result from the tube being pressed against a coil of intestine in this manner. The projecting end of the tube is received in a small sac made of oil-silk or rubber dam material, which is secured to the tube and filled with dressing material, this constituting the separate dressing of the tube. Glass-tube drains should be dispensed with at the earliest practicable moment, or as soon as less than a drachm is obtained by aspiration of the tube performed at intervals of four hours.

The wick or gauze drains to the number required are placed where needed and the outer ends led out of the lower angle of the external wound. The incision should be closed as much as possible consistent with free drainage and the easy removal of the wick or gauze drains.

In the presence of a small focus of infection limited to the region of the appendix, and particularly if the contents of the abscess cavity do not appear to be notably of a virulently infectious character, as suggested by the odor and appearance, the abdominal wound may be closed completely, a new opening being made for the emergence of the drains just above the crest of the ilium, and somewhat behind the plane of the anterior superior spinous process. There is no danger of ventral hernia occurring at this point, while an opening left for drainage at the site of the original incision is likely to be followed by hernia in a certain proportion of cases. The plan, therefore, of drainage at a point other than at the site of the operation wound itself should be employed whenever practicable. This plan is to be followed also when the intermuscular method is followed and septic conditions encountered. Should any infectious material flow over the wound edges in the course of the operation, this should be at once removed and the surfaces exposed to infection cleansed with hydrogen peroxide solution. Primary union will frequently follow.

The best method of drainage through the lateral opening is to pass a few strands of lamp wicking or a strip of gauze loosely through a section of rather large-sized rubber tubing. The wicking or gauze strip should be sufficiently long to include the limits of the region to be drained, but the rubber tubing should only appear flush with the peritoneum. The tube is to be prevented from slipping into the peritoneal cavity by a safety pin, passed through its wall only, at the level of the skin surface. This arrangement will prevent pressure upon the drain and consequent interference with its efficiency by the thick muscular structures of the flank. In addition to this, the removal of the wick or gauze drain and its replacement when necessary will be facilitated.

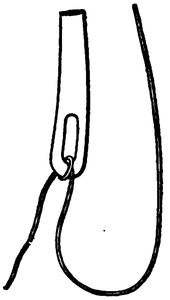
Closing the Abdominal Wound.

All articles used in the intra-abdominal portion of the technique are now to be accounted for. The surgeon, having placed a folded square of sterilized gauze or a laparotomy sponge over the presenting coils of intestine and tucked this under the abdominal wall at the wound edges, where it is steadied by an assistant, is ready to close the abdominal opening.

The Method of Closing the Oblique Incision.—The suturing of the abdominal opening is a matter of extreme importance in the case of the oblique incision at least. Here there is a tendency for the incision in the muscular wall in the abdomen, particularly that in the aponeurosis of the internal oblique, which passes almost at right angles to the direction of the fibres of that muscle, to separate. There is a more or less constant and variable force at work to produce this separation. The suture material must be of stable material, and the method chosen calculated to hold the individual layers with their incised edges in firm apposition until complete healing has been accomplished. Wherever the supplementary drainage opening is employed, the original abdominal opening can be closed completely, as well as in those cases in which drainage is not necessary; with proper suturing, and in the absence of sepsis, an effectual safeguard is afforded against subsequent ventral hernia. Even if a necessity for placing drains in the original wound exists, much can be done to prevent this unfortunate sequel by as few and as small drains as possible, and care in suturing.

The use of so-called "layer sutures" is the most rational method of effecting closure of the abdominal wound in all cases. The employment of buried catgut sutures for the purpose of bringing the incised edges of the different layers into apposition has been found untrustworthy in the case of the oblique incision in that softening of this material frequently takes place before firm union has occurred, with the result of permitting gaping in one or more of the planes, owing to a retraction of either the muscular or aponeurotic fascial layers, or both. In order to obtain the advantages of the buried suture, to be enabled to remove the latter at will, and yet not be compelled to depend upon an absorbable material, I devised and have employed with great satisfaction for the past eight years a removable layer suture. With this method of suturing, the different layers of the wall of the wound can be separately brought accurately in apposition as to their edges, each upon its own proper level, and as to their plane surfaces as well, the thread being crossed over each layer in turn as it progresses from below upward from the deeper portions of the wound to the integumentary surface. Either silkworm-gut, silver wire, silk or linen thread may be employed. The silkworm-gut is to be preferred. The present method of its application is as follows: The suture consists of a strand of silkworm-gut with a needle threaded on either end. In order to secure the needle firmly to the thread the latter is passed through the eye of the needle a second time, and from the same direction as at first, the resulting loop being then drawn taut (Fig. 50). Or the thread may be tied in the eye of the needle at each end of the strand.

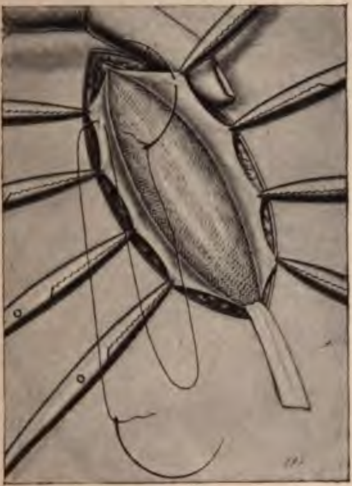
FIG. 50.



Method of securing the silkworm-gut suture to the needle.

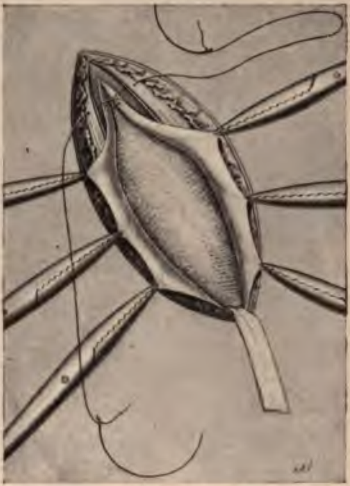
Each needle is passed through the peritoneum near the edges of the wound in the manner of a Lembert suture, so as to approximate surfaces of the peritoneum rather than the edges only (Fig. 51). The ends are then crossed to opposite sides of the wound and passed through the muscular and fascial layers (Fig. 52). Again the ends are reversed and passed through the skin (Fig. 53). In this manner the peritoneum is first secured, the muscular layers, and finally the skin, in turn. The crossed sutures are tied in pairs on either side of the wound. In order to guard against cutting of the skin from the silkworm-gut, the sutures are tied over "bolsters" of sterile gauze, or, what I find exceedingly convenient for this purpose, sections of thick-walled tubing of soft rubber (aspirator tubing) are used, the silkworm-gut being passed through the lumen of the tubing in the manner shown in Fig. 53. As the sutures are drawn taut the parts present the appearance shown in Fig. 54.

FIG. 51.



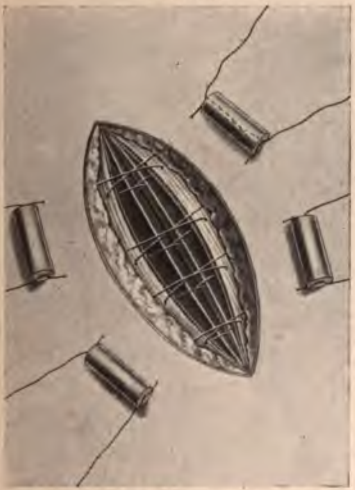
The first step of the removable layer suture: Method of securing approximation of the peritoneal surfaces.

FIG. 52.



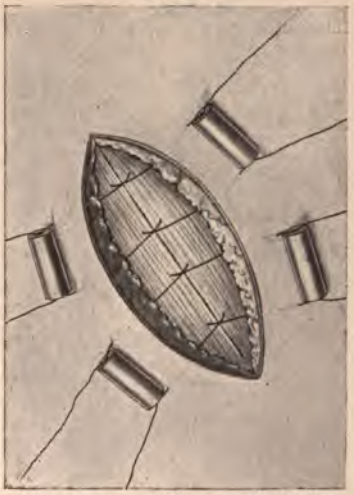
The second step of the removable layer suture. The peritoneal surfaces in process of approximation by the first layer of the crossed suture. The needles reversed and passed through the muscular and fascial layers.

FIG. 53.



The sutures again crossed or reversed and passed through the skin. They are then arranged in pairs, and the "bolsters" placed in position. The dotted line upon the upper right-hand bolster shows the manner of passing the silkworm-gut through the tubing.

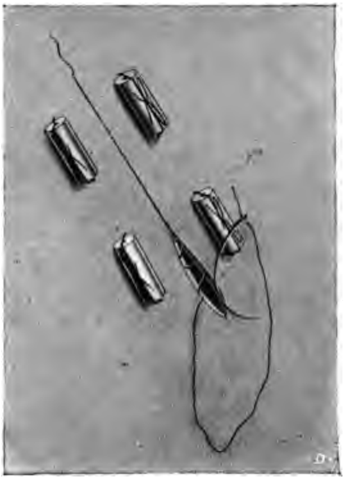
FIG. 54.



Appearance of the wound with the sutures drawn taut.

Upon "setting" the sutures in position the ends of each pair of the latter are tied over the corresponding bolster in turn in a double bow-knot, and the skin edges of the abdominal wound approximated by the intra-cuticular suture known as the Kendal Franks, or Marcy suture (Fig. 55).

FIG. 55.



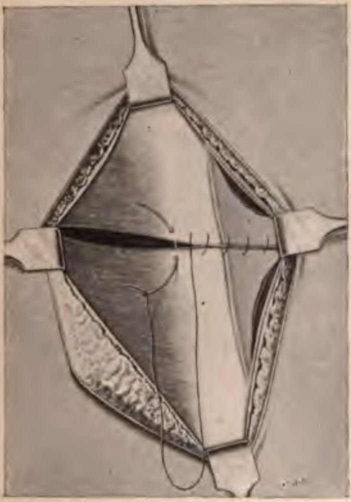
The bolsters "set" and the sutures tied. The skin edges in course of closure by the intra-cuticular suture.

This method gives all the advantages of buried layer sutures, and yet places completely within control the length of time the sutures are to remain in place. It likewise effectually disposes of the "dead spaces" between the plane surfaces of the layers usually left by the buried layer suture. Removal is accomplished by cutting the suture beneath the bolster on one side, and making traction upon the other end of the thread.

When the opening in the peritoneum is not more than two inches in length this may be closed by a purse-string or tobacco-pouch suture (Doyen), the remainder of the wound being closed by the removable layer suture above described. The chief advantage of employing this form of suture for closing the wound in the peritoneum lies in the fact that less opportunity is afforded for omentum or intestine to become adherent in the case of the little puckered depression upon the peritoneal surface left by the purse-string suture than is the case when a line of suturing is presented. Thus one of the causes of the subsequent development of ventral hernia is avoided.

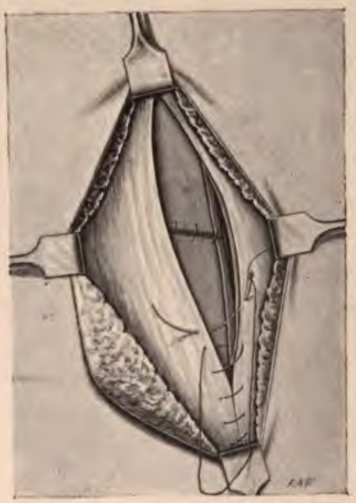
Closing the Intermuscular Incisions.—Owing to the fact that the lines of separation of the musculo-aponeurotic structures of the abdominal wall have but slight tendency to fall away from each other in abdominal section by the intermuscular methods, and therefore but slight tension is brought to bear upon the sutures, rapid repair and close union being the rule, absorbable sutures may be employed. Kangaroo tendon is to be preferred for this purpose. The relations which the suture lines bear to each other is a further guarantee against giving way of the abdominal wall under the influence of intra-abdominal pressure.

FIG. 56.



Suture of the transverse incision in the author's intermuscular method.

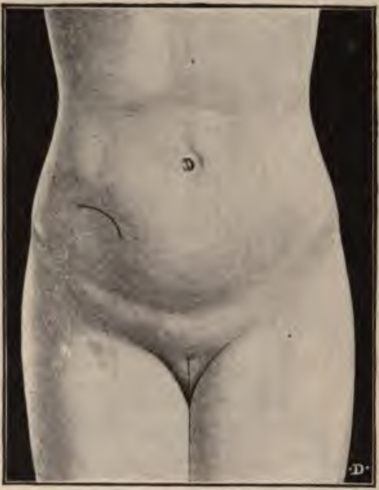
FIG. 57.



Suture of the aponeurosis of the external oblique in the author's intermuscular method.

The transverse incision is closed by a running suture, including all of its layers (Fig. 56). This will include the internal oblique, as well as the transversalis muscle and fascia, and the peritoneum. The external oblique is now sutured; in the case of my own method the suture will include, on the side toward the median line, both of the incised edges of the sheath of the rectus (Fig. 57). The muscular structure itself should not be included in the suture, since the interposition of this between the incised edges of the sheath, which may follow attempts to include the muscle, will prevent prompt union of the aponeurosis. The skin edges are secured by means of the intra-cuticular suture.

FIG. 58.



The author's intermuscular method. The shape and relative size of the skin incision after suturing.

Closing the Vertical Incision.—If the technique of opening the abdomen by the vertical incision is properly carried out, the invasion of muscular structure by the incision will have been slight, and this entirely behind the rectus abdominis muscle; which latter, in its turn, affords a firm support to the line of union. Here a suture of catgut, closing the opening behind the muscle, will suffice. A second layer closes the opening in the aponeurosis of the external oblique, care being taken to include both lamellæ of the sheath of the muscle. The skin incision is closed by a intra-cuticular or common interrupted suture. In septic cases the operator has the choice of draining through a supplementary incision or through the lower angle of the original opening. If the last-named course is followed, the portion of the opening to be closed is best sutured by means of the crossed suture.

CHAPTER XIV.

THE AFTER-TREATMENT.

In the great majority of cases of appendicitis operated upon in the early stage of the disease and prior to the occurrence of ulceration, perforation, gangrene, suppurative changes in the new formation-tissue about the appendix, or septic peritonitis, either local or general, the case will follow a practically afebrile and otherwise uncomplicated course, providing the surgeon has been successful in his endeavors to exclude infectious material from without during the operative procedure. The length of time required for the convalescence will occupy about two weeks or even less under these circumstances. The same may be said of chronic relapsing appendicitis operated upon in the interval of comparative quiescence, as well as cases of the recurrent type of the disease operated upon after the subsidence of an attack.

In cases operated upon later in the disease, in which most decidedly septic conditions are present, the after-course will be favorable in proportion to the efficiency of the natural safeguards in protecting the peritoneal cavity from invasion by infectious material prior to the operation, or the success of the surgeon's efforts in preventing infection, either from without or as the result of removing the barriers in the form of adhesions about the appendix, which constitute the safeguards above alluded to. More or less drainage will be necessary in the majority of cases operated upon after the second day of the existence of the disease, as well as in not a few cases operated upon even prior to this time. I have never deemed it best to close the abdominal wound in cases in which pus or sero-purulent fluid was present, preferring under these circumstances to leave a few strands of wicking drain, at the very least, at one corner of the former, or to drain through a supplementary incision (see page 192). After a few days these may be removed and the portion of the wound remaining open closed by secondary suturing.

The general after-treatment, exclusive of complications, is that of abdominal section in general. For the purpose of allaying nausea and vomiting, favoring normal peristalsis, and particularly the passage of fluids from the abdominal cavity to that of the pelvis, where, even though septic, these do comparatively little harm, immediately upon being returned to bed the patient should be placed in the elevated head-and-trunk position. The ingestion of fluids is not to be restricted save by the occurrence of persistent and intractable vomiting. Their administration by the stomach is to be supplemented by rectal enemata of decinormal saline solution. The administration of milk or other fluid diet may commence as soon as the stomach is found to retain simple water, and the quantity should be so regulated as to reach full milk diet at the end of twenty-four, or at the latest forty-eight, hours. This should be rapidly supplemented by farinaceous food preparations and meat broths, and, if all goes well, even solid food may be early resorted to. In strictly aseptic and otherwise uncomplicated cases, with the abdominal walls properly supported by broad strips of adhesive plaster placed over the dressings, the patient may be allowed to sit up after the first two weeks. No binder or other abdominal support need be worn after complete healing of the abdominal wound has been secured. Care should be taken that no undue strain is brought to bear upon the parts for several months. If the patient is compelled to undertake a laborious occupation before this time he should wear an abdominal support.

The occurrence of excessive vomiting, or of troublesome flatulence too high up to be relieved by the rectal tube or enemata, may require the use of lavage. This not only serves to rid the stomach of gas which has found its way into that viscus, but of accumulated viscid mucus as well. If lavage is practised soon after the operation, saliva loaded with the anesthetic agent, and which has found its way into the stomach, will be thus gotten rid of, and the effects of this in prolonging the anesthetic effect, as well as provoking efforts of retching, prevented. After the stomach has been thus thoroughly cleared out an occasional quarter of a grain dose of muriate of cocaine and five grains of oxalate of cerium will greatly assist in relieving the nausea.

The occurrence of distention of the abdomen from accumulation of gas should be carefully watched for, and the patient occasionally interrogated as to the passage of flatus. Failure to pass gas per rectum should be met by the administration of simple soap-suds enemata, and distention promptly relieved by an enema designed to produce a decidedly stimulating effect upon the muscular apparatus of the intestines, such as that containing turpentine, glycerine, etc. A favorite combination for this purpose consists of an ounce of sulphate of magnesium, four and a half ounces of water, a half ounce of glycerine, and two drachms of spirits of turpentine. To this is sometimes added a drachm of powdered inspissated ox-gall.

If the stomach is unable to retain nourishment, nutrient or stimulating enemata may be administered if necessary. Pain is to be controlled by hypodermatic injections of sulphate of morphia.

In the absence of distention, and with the occasional passage of gas per rectum, the surgeon need feel no anxiety about moving the bowels until after the third or fourth day following the operation. If no infection is present, this will be easily accomplished at this time. If the exigencies of the case and the character of the attack have permitted it, the patient's bowels will have been thoroughly moved as a part of the preliminary treatment, and hence the intestinal tube will be comparatively empty for the first forty-eight or seventy-two hours following the operation. At the present time early movements of the bowels are not looked upon as preventive of peritonitis although the surgeon will feel a sense of relief when a number of fluid movements of the bowels are secured by saline cathartics, for this will assure him, as a rule, of the absence of sepsis. Under certain circumstances, as, for instance, where typical excision, proper ligature of the stump, or other trustworthy measures of shutting off communication with the intestinal canal have been impracticable, or in which the removal of the appendix has not been deemed safe, fecal extravasation, either from an insufficiently secured stump or from a perforated appendix, is to be feared. In these cases an additional forty-eight or seventy-two hours should be allowed to elapse before commencing the use of cathartics, with the view of assuring sufficient strength to the adhesions to prevent direct infection of the peritoneum through rupture of these from forced peristalsis. In the meanwhile the use of the rectal tube, enemata, lavage, and other measures conducive to the patient's comfort should be employed.

In the average case, commencing at the end of the fourth or the beginning of the fifth day, half-grain doses of calomel are given half-hourly until six have been taken. An hour after the last dose a half-ounce dose of sulphate of magnesium is administered, dissolved in an ounce or two of Vichy or other carbonated water, with a heaping teaspoonful of finely cracked ice added[1] Should the bowels delay in responding to the medication beyond three or four hours, drachm doses of the sulphate of magnesium are to be given hourly until the result is reached.

The external dressings should be removed and replaced by others as they become soiled, in accordance with the rules governing the treatment of wounds in general.

In those cases in which adhesions are broken down, and the general cavity of the peritoneum invaded, the wick or gauze drains which isolate the site of the appendix should be left undisturbed for upwards of three or four days until strong protective adhesions have formed beyond the drains.

In order to facilitate the removal of the drains, and to disturb the parts as little as possible while this is being done, the strips should be removed in the reverse order from that in which they are placed in position. Wicking may be removed a single strand at a time.

After withdrawal of the drains a light packing of gauze may be placed in the wound. This packing will usually occupy only the superficial portion, for the reason that the spaces formerly occupied by the drains will have been filled by the return of the displaced coils of intestines. The amount of packing will be progressively lessened at each dressing. As soon as the local septic conditions are abolished, either strapping or preferably secondary suturing should be applied to complete the closure as rapidly as possible. The application of provisional sutures at the time of the operation will permit of a painless final closure of the wound. In case a small supplementary opening has been made for drainage above the iliac spine or in the flank, no suturing will be required upon final removal of the drain. Surgical hernia does not occur in these situations.

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[1] Equal quantities of sulphate of magnesium and finely cracked or shaved ice, with a half-ounce each of orange and lemon juice from the fresh fruit, is a generally acceptable method of administration.

When the abdominal wound is entirely closed at the time of the operation the dressings need not be disturbed, as a rule, until from a week to ten days, when the sutures may be removed. Exceptions may be found to this rule in cases in which stitch abscesses or other complications are present.

In cases in which diffuse septic peritonitis is already present, together with invasion of the system at large by the rapid absorption of septic material from the intestinal and diaphragmatic areas of the abdominal peritoneum through the large lymph trunks and stomata present in these areas, it is imperative that whatever measures are calculated to give the patient the best chance for life should be instituted promptly. The vomiting following the anesthetic under these circumstances will frequently prevent the retention of cathartics, and greatly embarrass the surgeon's efforts to secure movements of the bowels. Lavage, while the patient is still under the influence of the anesthetic, may be practised if the head is sufficiently lowered to prevent whatever fluid which finds its way alongside of the tube in returning from the stomach from finding its way into the glottic opening. Following the lavage a full dose of sulphate of magnesium may be placed in the stomach through the tube while the latter is still in position. This will usually insure the retention of at least this first dose of the cathartic by the stomach. Persistence of the vomiting will preclude the repetition of the dose of sulphate of magnesium, and some other form of cathartic may be tried. A pill which I have found useful, and which my hospital internes call the post-laparotomy pill, consists of colocynth, jalap, podophyllin, and strychnia. If this pill is not retained, small doses of calomel may be tried in alternation with the pill. The preliminary administration of a combination of muriate of cocaine and oxalate of cerium will sometimes assist in the retention by the stomach of the cathartic.

The most trustworthy means, in my experience, of combating both vomiting and arrest of peristalsis, as well as of preventing further absorption of septic material from the peritoneal cavity, is that of placing the patient in the elevated head-and-trunk position.

In addition to the treatment of pre-existing septic peritonitis already laid down, its further management will be best conducted upon the lines laid down in the paragraphs upon septic peritonitis occurring as a complication.

Post-Operative Complications.

Post-Operative Peritonitis.—Inflammation of the peritoneum as a post-operative complication following abdominal section for appendicitis assumes a gravity in direct proportion to the extent of the lesion. It results from mechanical injuries sustained by the serous surfaces and infection, the former acting as the predisposing, and the latter as the exciting cause. The infection may have its origin either in the original septic focus which necessitated the operation, from without as the result of failure of the aseptic technique, or from within the intestinal canal. In the latter case the *locus minoris resistentiæ* is established in the wall of the intestine and infection takes place through the latter, or direct infection occurs from a lesion of the intestine permitting escape of its contents.

In the localized form of the disease the peritoneum in the immediate neighborhood of the field of operation is alone involved. The channels of infection if small become readily closed against an extension of the latter by the products of the inflammation of the channels themselves (thrombo-lymphangitis). With comparative small areas of the serous surfaces involved and infection limited both as to amount and virulency, this form of peritonitis is not of itself to be dreaded by the surgeon. In most instances it scarcely passes beyond the limits of the supposed requirements of repair. Impairment of the function of the bowel may result, however, from the presence of peritoneal adhesions resulting from localized peritonitis, a displaced coil of intestine becoming fixed in a position to lead to angulation and intestinal obstruction.

Again, the inflammatory process may extend beyond the field of operation, occupying a limited area but giving rise to characteristic symptoms of the disease corresponding in severity to the extent and relative virulence of the infection. This area represents but a fractional portion of the entire peritoneal surface, however, and the infection may be of a character to be easily overcome by the germicidal power of the leucocytes (macrophages of Metchnikoff) contained in the serous effusion in the peritoneal cavity. In this, the limited form of peritonitis, as it may be termed, the disease is marked by comparatively mild symptoms, and these mostly of a local character. Pain and tenderness are present within the area of inflammation; there is a limited amount of distention. The temperature is but slightly elevated and the pulse only moderately accelerated.

This limited form of the disease may subside after giving the surgeon a day or two of anxiety, or it may extend so as to encroach more and more upon the still uninvaded peritoneum, constituting the form clinically known as "spreading peritonitis." This latter form of peritonitis may only too frequently prove to be the precursor of the more grave form about to be described. While the serum of the peritoneal cavity, under conditions involving peritoneal leucocytosis, possesses, to a certain extent, the power of destroying even the most virulent micro-organisms, there is a limit to this power, and when this is reached the bacteria remaining undestroyed find at once the proper pabulum for their numerical increase as well as the development of the toxic substances upon which their pathologic properties depend. Prompt treatment, therefore, should be instituted for the purpose of forestalling excessive distention and paralysis of peristalsis. This is done by facilitating drainage of septic fluids into the pelvis by means of the elevated head-and-trunk position, securing early and frequent watery discharges from the bowels by means of saline cathartics, these also serving to eliminate the toxic products of the infection. The ice-coil should be kept continuously applied.

Finally, *diffuse septic peritonitis* is the most fatal of the post-operative complications of abdominal section for appendicitis. As its name implies, it is a diffuse form of septic peritoneal inflammation, the lesion invading, to a greater or less extent, remote portions of the peritoneal surfaces. An absolutely general or universal peritonitis is probably a very rare affection, but few patients surviving the general septic infection present before the peritonitis indubitably becomes general. It usually depends upon the more virulent of the bacteria which invade the cavity of the peritoneum, namely, the streptococcus, and is followed by a train of most dangerous symptoms due to septic absorption from the extensive surface of this enormous lymph-sac, particularly its diaphragmatic and intestinal areas.

The occurrence of post-operative diffuse septic peritonitis is usually postponed for from twenty-four to forty-eight hours following the operation, more frequently the latter. If more or less septic peritonitis is already present at the time of the operation, this interval, of course, will not be observed. The supervention of septic symptoms is exceedingly insidious. A gradual increase in the pulse-rate, and slow but persistent rise of temperature, particularly if these are conjoined with an obstinately constipated condition of the bowels, should always arouse suspicion. If vomiting sets in, both nourishment and medicines being rejected, and this be sufficiently removed, say by six or eight hours, from the vomiting resulting from the anesthetic, and, in spite of efforts to move the bowels, no indications of passage of flatus from one portion of the tube to another are obtained upon auscultation of the abdomen, the diagnosis is beyond doubt. In the progressive and hopeless cases the course will be typical, as a rule. The stomach rejects everything placed in it. The accumulation of gas and some of the fluids swallowed by the patient leads to progressive and excessive distention of the abdomen. Cold, creeping sensations and profuse perspiration set in. The surface of the body is bathed in a cold, clammy sweat. Attempts to sustain the patient, by means of stimulating and nourishing enemata, prove futile for the reason that these are promptly rejected. Jactitation now comes on; the peculiar muscular pains of sepsis cause the patient to become very restless, and this, conjoined with delirium, necessitate extra watchfulness. The vomited matter becomes dark brown. The anxious expression of the face gives place to one of apathy or absolute hopelessness. The temperature may rise to from 105° to 107° Fahrenheit; the pulse becomes too rapid to count, or it may be absent at the wrist altogether. The finger-nails become blue, the skin is a dark, muddy hue; moisture exudes apparently from every outlet upon the surface.

In the treatment of this complication, free drainage through the intestinal canal, if this can be obtained without provoking or aggravating vomiting, offers the best chance to the patient in the very commencement of this complication. The patient should be placed in the elevated head-and-trunk position, if this has not already been done, to facilitate the passage of fluids from the abdominal into the pelvic cavity. The ice-coil should be employed on account of its tendency to relieve pain, if for no other reason. As a rule, its use greatly increases the comfort of the patient.

With the development of intestinal paresis increased difficulty in effecting movements of the bowels is experienced. Small doses of calomel in conjunction or alternating with the sulphate of magnesium are sometimes useful. In connection with this, strychnia is given, hypodermically, in $\frac{1}{20}$-grain doses.

While the condition of intestinal paralysis is usually a symptom of a diffuse septic peritonitis, it may occur in cases in which there is an absence of the usual symptoms of peritonitis. Under these circumstances it is probably due to septic conditions having their origin in the peritoneal cavity. The germs upon which the septic conditions depend may not as yet be demonstrable, but their toxic products probably exert their primary influence upon the muscular fibres of the intestinal tube. Whatever its origin, it will, in all probability, prove fatal if the paralysis becomes complete.

While the surgeon cannot be certain during the first forty-eight hours that anything is seriously wrong with the patient, the mere fact that no gas passes per rectum, that nausea is constantly threatening, and vomiting easily provoked will cause him some uneasiness of mind. If, in addition to this, the bowels do not move promptly, his worst fears are in a fair way to be realized, and he will be impelled to redouble his efforts in this direction until either these are successful or until it is evident that intestinal paralysis is present and that they are not likely to prove successful. Under these circumstances continued stimulation of the motor-nerve apparatus of the intestinal muscular structure will not only prove futile, but probably harmful.

The question of the usefulness of the anti-streptococcic serum in this condition is still an unsettled one. Twenty-five c.c. of the serum may be injected subcutaneously and repeated every six or eight hours. Intravenous saline infusion may also be tried. The use of the latter in connection with strychnia, particularly if the strychnia has been employed in large or frequently repeated doses, is inadmissible; sudden dissemination of this drug may lead to its toxic effects.

The question of reopening the abdomen and cleansing it of toxic material is one that should receive careful consideration at the hands of the surgeon. To be of use, however, this must be resorted to early, and should be thoroughly and efficiently done. Besides the advantages resulting from the removal of septic material from the peritoneal cavity by flushing with large quantities of normal saline solution, an increased advantage may accrue from the employment of the latter in that it confers peritoneal immunity for a certain length of time by producing increased peritoneal leucocytosis (Issaeff), thus reinforcing the subsequently transuded serum with an increased number of macrophages, whose office is to invest the microbic invaders in such a manner as to imprison and sterilize them. In order to effect this cleansing process in a thorough manner, it may be necessary to eventrate in the manner described in dealing with diffuse septic peritonitis as encountered in the course of the operative procedure. The postural method of emptying the abdominal cavity and provision for artificial drainage should follow (see treatment of diffuse septic peritonitis).

Finally, the administration of opium is called for to arrest the jactitation and ameliorate the sufferings of the patient. It may be given hypodermically in the shape of morphine with advantage. Not the least of the benefits derived from its use is the lessening of the number and increase in the depth of the respiratory movements through the relief which it affords to the pain attending the action of the diaphragm. An increased amount of oxygenation of the tissues of the body is thus afforded.

Intestinal Obstruction.—If symptoms of mechanical intestinal obstruction develop, as evinced by absolute failure of gas to pass by the rectum, and persistent followed by fecal vomiting, progressive distention of the abdomen, prostration and signs of peristaltic movements obtained by the stethoscope applied to the abdominal walls, these should be met by a prompt reopening of the abdomen, and search for and relief of the imprisoned portion of the intestine.

The obstruction is most frequently due to angulation, though ileus sometimes occurs. Cases will occasionally be observed in which the obstruction is due to mechanical causes, to which intestinal paralysis is added. Under these circumstances auscultation of the abdomen will not be available in differentiating these two conditions.

The occurrence of vicious adhesions may lead to intestinal obstruction at a period of time comparatively remote from the operation, and even after convalescence has been thoroughly established. The following case illustrates this condition :

M. C., aged fifteen, was operated upon for acute appendicitis in my service at St. Mary's Hospital. The appendix was removed, and the abdominal wound was closed, with the exception of about an inch at the lower angle, where a small gauze-drain emerged. The latter was dispensed with at the fourth dressing. The patient was perfectly well, as far as the appendicitis was concerned, at the end of three weeks. Her mother gave her a banana to eat on the afternoon of the twenty-first day. After eating this she was seized with what appeared to be an attack of acute indigestion. During the night the abdomen became tympanitic and vomiting occurred. This circumstance, together with the intractable character of the latter, and the failure to obtain a movement of the bowels or even the passage of flatus by means of high enemata, demanded a second laparotomy. It was then discovered that a portion of the ileum had become attached by adhesions near the former site of the appendix. The adhesions were so placed as to bind down a loop of small intestine for a considerable distance toward the median line from the ileo-cecal valve. The ballooning of the intestine by the accumulation of gas, resulting from the attack of indigestion, had produced a twist of a loop of intestine upon itself at its mesenteric attachment, thus causing both obstruction and rapid strangulation of the tissues of the intestine itself.

Fecal Communication and Fecal Fistula.—Fecal communication between the cecum and the wound-cavity may occur during the after-treatment. In one case in my hospital service, a communication between the wound-cavity and a coil of small intestine also occurred, but in this case tubercular ulceration was supposed to have been the cause. Fecal communication usually has its origin in some condition of the vermiform appendix which prevents the proper suturing of the opening in the cecum left by the removal of the appendix. The occurrence of this accident in a case in which the abdominal cavity had been entirely closed would lead to fecal extravasation and the most disastrous consequences. Its occurrence is usually limited, however, to the very class of cases in which entire closure of the abdominal wound is contraindicated.

Fecal communications of this kind lead to permanent fecal fistulous openings much less frequently than would be supposed. With due attention to cleanliness of the wound, and encouraging healthy granulations, together with care in securing frequent movements of the bowels by enemata, the majority will close before the final closure of the wound itself. Where the fecal communication is due to ulcerative action in the wall of the intestine at a point other than at the site of the appendix, a secondary plastic operation may be required for its closure. Such attempts are sometimes abortive, owing to difficulties arising from the presence of adhesions. Under these circumstances an ileo-sigmoid anastomosis with total elimination of the large intestine, thus diverting the fecal current away from the site of the fecal fistula, should be done, following which, if necessary, and at a subsequent operation, the plastic procedure may be applied.

Thrombo-Phlebitis.—Lennander attributes the occurrence of thrombo-phlebitis as a post-operative complication in this class of cases to blood-stasis resulting from the enforced lying in bed. It is most apt to occur in illy-nourished patients, particularly those already suffering from varices.[1] With this complication to contend with, the patient's stay in bed will be considerably prolonged; the affected limb will remain weak, and become edematous upon standing, for several months.

In thrombo-phlebitis it is more than probable that the process of thrombosis originates at the point of infection, and commences with slight depositions of blood plaques at the vascular wall, also the site of white and, under certain circumstances, of red blood-corpuscles as well. This deposition, or conglutination (Eberth), in the presence of fibrin ferment and a slowed blood-current, produces coagulation. Once the process is initiated, further coagulation is increased by the liberation of new fibrin ferment from the imprisoned white blood-corpuscles in the thrombosis itself. By this combined action of conglutination and coagulation the lumen of the vessel becomes rapidly obstructed, the coagulation extending distally to the next larger branch, where the current becomes free

[1] Centralblatt für Chirurgie, 1899, pp. 553–560.

again. With a sufficiently retarded current the coagulation may extend proximally as well.

The fibrin ferment is quickly distributed and destroyed in a rapidly moving blood-current. In the preventive treatment of thrombo-phlebitis, therefore, the indications are to favor the rapid passage of the blood in the return circulation from the lower extremities. This is best accomplished by raising the foot of the bed; the shoulders of the patient, at the same time, are supported by pillows, to relieve the increased pressure in the upper portion of the body and head, since, as soon as the flow of blood through the iliac veins empties into the inferior vena cava, its further progress toward the right ventricle is hastened by the aspirating effect of each respiratory movement. Elevation of the lower extremities alone will not suffice; the pelvis must be elevated as well.[1]

It is unnecessary to remark that this position should not be assumed with peritonitis present or threatening. It is far better to take the risks of thrombo-phlebitis than to risk infecting the organism with septic material from the abdominal cavity through the large lymph-trunks and stomata of the diaphragmatic and intestinal areas.

Once the condition is established, the treatment will consist of rest in the horizontal position and enveloping the affected extremity or extremities in cotton batting or flannel roller bandages. Counter-irritation by tincture of iodine pencilled along the femoral vein, which is usually the site of marked tenderness, and belladonna ointment applied upon lint to the neighborhood may be followed as routine measures of treatment.

Mucous Sinus.—The occurrence of a mucous sinus has been met with occasionally. This results from leaving exposed and failing to destroy the mucous membrane left in the stump of a ligated appendix in cases in which a typical procedure in dealing with the latter has not been possible. If permanent closure is not effected after thorough curetting and packing with gauze, a few drops of equal parts of carbolic acid and tincture of iodine may be carried to the bottom of the sinus by means of a proper syringe with advantage.

Ventral Hernia.—This untoward occurrence occasionally results from operations for appendicitis, in consequence of the presence of septic conditions necessitating drainage through the operation wound, a failure to properly approximate the incised edges of the different layers of the abdominal wall in aseptic cases, or the subsequent occurrence of septic conditions in the latter demanding premature removal of the sutures. The fact that it scarcely ever occurs in cases in which the opportunity is offered of closing the abdominal wound at once and securing primary union of the latter in all its layers constitutes an argument for early operative interference in appendicitis.

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[1] Lennander, op. cit.

In ventral hernia there is more or less stretching of the wound cicatrix and separation of the edges of the original opening in the abdominal wall. This is favored by the presence of adherent intestine or omentum, or both, at the line of peritoneal union, these acting as a wedge, which, under the influence of intra-abdominal pressure, gradually stretches the cicatricial tissue, uniting the structures of the abdominal wall.

This increases as time goes on, the cicatricial tissue stretching more and more under the influence of the intra-abdominal pressure, until finally a distinct bulging occurs, which, upon reduction, or upon the patient assuming the horizontal position, reveals the presence of a distinct hiatus in the musculo-aponeurotic structures of the abdominal wall, the thinned-out cicatrix in the skin, and the peritoneum alone filling the gap.

Ventral hernia thus originating should be treated operatively. The key to successful operation in this class of cases consists in completely dissecting away every trace of cicatricial tissue, splitting the abdominal wall in the direction of its layers to accomplish this, if necessary. In this manner an absolutely new start is made in the closure. Then, commencing with the peritoneum, this and the muscular and aponeurotic layers and finally the skin are to be separately sutured in turn in layer sutures. This may be done with kangaroo tendon, or, what I prefer, the crossed suture of silkworm-gut (see closure of the abdominal wound).

Wound Complications.—In cases in which the abdominal wound is not closed immediately, it will be subject to the same interruptions of the healing process as wounds in other situations exposed to septic influences. These are due to the presence of the common pus organisms, the colon bacillus, and probably others not yet identified. In the following case the healing process was complicated by the presence of a micro-organism to which, as found in man, destructive pathogenetic properties have not heretofore been ascribed:—

A. M., aged thirty-five, male, was admitted to Saint Mary's Hospital with the history of having been attacked in the early hours of the morning of the previous day by all of the symptoms of acute appendicitis of an unusually severe character. A right lateral laparotomy revealed an appendix whose distal two-thirds was completely gangrenous. It was buried in a mass of adhesions which had also taken part in the gangrenous process. The appendix was ligated at the base, and excised. Unfortunately, the circumstances surrounding the operation were such as to prevent a proper bacteriological examination. On the second day an elevation of temperature necessitated a redressing of the wound. It was found that the gangrenous process had extended from the cavity to the edge of the wound, and thence into the abdominal parietes toward the umbilicus, involving a space as large as the palm of the hand. The area of gangrene was marked by an irregular outline, numerous blebs, and considerable infiltration of the tissues. Stab inoculations in a sterilized agar-gelatine tube were made, and pure cultures of the *bacillus pyocyaneus* of Gessard were obtained from the depths of the integumentary tissues.

In cases otherwise uncomplicated stitch abscesses may occur. These will necessitate the removal of the sutures securing the skin edges at least, and frequently those at a greater depth as well. In the case of the crossed suture of silkworm-gut, curetting along the suture track when this passes through the skin and packing this with narrow strips of iodoform gauze will sometimes suffice.

Deep Pelvic Abscess.—An exceptionally long appendix, placed in the SE position (Fig. 9), may lead to an infection of the tissues within the pelvis, the results of which may not be apparent until a considerable time has elapsed after the beginning of the disease, or after the operative procedure instituted for the removal of the diseased appendix. The following case is of exceptional interest in this connection:

M. E. S., female, aged twenty-one, was admitted to the Methodist Episcopal Hospital, May 14, 1893, suffering from a rapidly developing attack of appendicitis. No previous attack had occurred. The abdomen was opened by the usual right-sided vertical incision, and the appendix, which was ulcerated and perforated, was removed. Its position was directly downward and inward, across the vessels, and its length was five inches. The cecum was placed abnormally low, and the appendix reached well down and into the pelvis and seemed to lie between the rectum and the uterus. The appendix was removed. The depths of the infected area were cleansed as thoroughly as possible, and a drain of iodoform gauze placed in position. The external abdominal wound was only partially closed. The patient was discharged from the hospital after a six weeks' convalescence with the wound entirely healed.

On October 2, 1893, nearly five months after the operation, she was again admitted to the hospital, with a history of having suffered from what was thought to be malarial fever. An examination disclosed a fluctuating tumor, situated between the uterus and the rectum, which filled the entire *cul-de-sac* of Douglas. The tumor was found to be a large abscess, located behind the uterus. The rectum was nearly perforated by the abscess. Both tubes and ovaries were normal.

Secondary abscesses, either intra-pelvic or located elsewhere, should be evacuated by way of the most available and safest route.

Hemorrhage from Gangrenous Involvement of the Iliac Vein.—Fatal hemorrhage may follow invasion of the iliac veins by the gangrenous process in the case of a gangrenous appendix. The instance given below of the invasion of the right iliac vein following operation came under my observation:

H. W., male, aged fifty-seven. Patient was seen by me January 22, 1891, in consultation with his family physician, Dr. Cruikshank. The usual symptoms of an acute appendicitis had accompanied the outset of the attack, five days previously. He had apparently entered upon a safe convalescence, when grave symptoms suddenly supervened. An immediate laparotomy was performed. A gangrenous appendix was found in the SE position (Fig. 9), imbedded in a mass of adhesions which were also in a gangrenous condition. The wound cavity was thoroughly cleansed and drained, after which the patient's condition improved. On the eighth day, while the wound was undergoing its usual daily redressing, a gush of blood followed the withdrawal of the gauze drains. This was temporarily controlled by the finger passed to the bottom of the wound cavity, and a tampon, arranged as a graduated compress, was firmly placed in the cavity and controlled the hemorrhage. He never rallied from the loss of blood, however, and died upon the following day.

CHAPTER XV.

APPENDICULAR LESIONS FROM FOREIGN BODIES; TYPHLITIS, PERITYPHLITIS AND PARATYPHLITIC ABSCESS.

Appendicular Lesions from Foreign Bodies.—The earliest authentic record of an appendicular lesion produced by a foreign body is that reported by Mestivier in 1759.

> A man, forty-five years old, was admitted to the Hôpital St. André de Bordeaux, suffering from a fluctuating tumor in the umbilical region to the right of the median line. The tumor upon being opened discharged a pint of pus. A fatal termination took place, and at the autopsy a pin was found, encrusted with earthy matter, which had served as the starting-point of the disease by perforating the appendix vermiformis ceci.

Of the foreign bodies found in the vermiform appendix and giving rise to the appendicular lesions, the common domestic pin occurs probably more frequently than any other. The histories of thirty-three indubitable cases of this character have been collected and published by Dr. James F. Mitchel.[1]

A history of the patient having swallowed a pin is seldom obtained. The improbability of obtaining such a history is increased by the fact that almost half of the cases reported have occurred in children under ten years of age (fifteen of the cases in Mitchel's list). That the pin gains access in some way other than by carelessly placing pins in the mouth, as, for instance, with food and drink, in addition to the absence of a history of having swallowed a pin, is further strengthened by the fact that a larger number of cases are reported as occurring in men than in women (ten out of seventeen), it being generally conceded that women, because of their duties in dressing children, as well as in performing their own toilettes, place pins in the mouth as a temporary resting place much more frequently than men.

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[1] The Johns Hopkins Hospital Bulletin, Nos. 94, 95, 96 and 99. Two of Dr. Mitchel's cases, in which the pin perforated the cecum, and one in which the pin was found at the bottom of an abscess cavity, the appendix not being identified, are not included in this number; Ruysch's case (Amsterdam, 1691) is not considered for the same reason

The absence of knowledge as to when the pin was swallowed also precludes the possibility of ascertaining how soon thereafter the symptoms denoting the presence of the foreign body may make their appearance. In the cases reported, the great majority developed an acute attack without preceding symptoms, with rapid perforation and abscess formation.

The pin may remain free or become imbedded in solid fecal matter. It may likewise form the nucleus of an enterolith. In about one-half of the reported cases the body of the pin was more or less imbedded in fecal masses or encrusted with deposits of earthy matter; in the majority, however, the point of the pin was free.

In the majority of cases in which the position of the pin was noted, it lay with the head directed toward the distal extremity of the appendix. The pin has also been found lying crosswise; in one case in Mitchel's collection two pins were found lying side by side in this position.

Perforation of the appendix by the pin takes place in the large majority of cases (thirty-one out of thirty-three); in one of the cases in which perforation did not take place the pin was bent. With the pin transversely placed double perforation may take place (one case), the openings being in opposite walls of the appendix. Adhesions between the appendix and an adjoining coil of intestine may lead to a pathological anastomosis between this organ and the latter, through which the pin may pass and enter the gut, and even perforate the latter in its turn, as occurred in a case coming under Mitchel's personal observation.

Other pointed or elongated foreign bodies have been found in the appendix, such as spicules of bone,[1] a tooth-brush bristle,[2] a wisp of broom, a piece of corn-husk,[3] and a fin of a fish.[4]

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[1] Coleman: New York Medical Record, 1895, XLVIII, 639. Murphy: Journal of the American Medical Association, 1894, XXII, 302. Thompson: British Medical Journal, September 23, 1892.

[2] Ward: Transactions of the Pathological Society of London, 1855, vi, 197.

[3] Personal communications from Dr. Schooler, of Des Moines, and Dr. Abbe, of New York, to Dr. Mitchel, op. cit.

[4] Ashton: Medical Bulletin, Philadelphia, 1894, XLVII, 345.

Finally there is a class of bodies the passages of which into the lumen of the appendix vermiformis is favored by the fact of their being small and heavy, and in most instances quite smooth, namely, shot and bullets. A case in which one hundred and twenty-two robin-shot were found post-mortem in the appendix is reported. Their presence does not seem to have inconvenienced the individual during life.[1] Stone, of Omaha, and Ransohoff, of Cincinnati, each removed an appendix containing a bullet as the exciting cause of appendicitis.[2] Potherat, in the course of an operation for supposed inguinal hernia in a case in which inflammatory symptoms had supervened, found the contents of the hernial sac to consist of an inflamed appendix containing soft fecal matter and a small metal plate two millimetres long.[3]

Typhlitis and Perityphlitis.—Inflammation of the cecum, or typhlitis, and of the peritoneum covering the cecum (perityphlitis) presents a clinical picture in some instances so strikingly resembling that of appendicitis that a differential diagnosis is impossible. This is particularly true if early perforation occurs, and the paracecal structures become the seat of a rapidly-developed paratyphlitic abscess.

All cases of typhlitis, however, do not go on to extension of infection and suppuration. Cases come under observation in which, after periods of time varying from forty-eight hours to a week, the symptoms subside coincidently with the evacuation by the bowel of fecal masses and the disappearance of evidences of fecal impaction in the cecum and ascending colon. These cases are quite apt to occur in elderly persons, and are to be classed with the cases of simple catarrhal inflammation, the result of fecal accumulation (the stercoral typhlitis of Lennander).

Paratyphlitic Abscess.—Suppurative inflammatory conditions in the right iliac region, originating in the neighborhood of the cecum, in which operation discloses a normal appendix, or in which the latter is not primarily involved as shown by the presence of a perforation of the cecum, the appendix being infected from lying bathed in infectious material in an abscess cavity, are sometimes observed. Abscesses in this neighborhood have even been observed some time after the removal of the organ for appendicitis. It must therefore be conceded that abscesses in this region are not exclusively appendicular in origin, in spite of the generally received opinion to the contrary,—an opinion now so widespread that recent writers, as a rule, entirely ignore the possibility of their occurrence from other origin.

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[1] Holmes: New England Quarterly Journal of Medicine and Surgery, Boston, 1842-43, I, 257.

[2] Mitchel: Op. cit.

[3] Bull. et mém. de la soc. de chir. de Paris, Vol. XXIV, p. 678.

Paratyphilitic abscess is the result of a suppurative inflammation of the connective tissue about the cecum. This may occur in the normal structures or in the adventitious tissue thrown out as a result of inflammatory conditions of the cecal wall (typhlitis) and its peritoneal covering (perityphlitis). The inflammation of the cecum may have its origin in fecal accumulation, this giving rise to a simple catarrhal inflammation; this may, in its turn, be followed by a parietal typhlitis. The latter, if located near the junction of the appendix with the cecum, may give rise to symptoms of appendicitis. Dauber describes a case of this kind in which the operation disclosed a small abscess in the wall of the cecum near the base of the appendix. The pressure against the site of the appendiculo-cecal orifice caused stenosis of the latter. The serous covering of the appendix was normal. Pus was found in the cavity of the latter. No adhesions were present.[1]

The seat of the inflammation in parietal typhlitis is in the interstitial or intermuscular structures of the wall of the cecum, with engorgement of the vessels and the presence of an exudate in the perivascular spaces. Or it may occur from nutritive disturbances of the wall of the bowel. These nutritive disturbances may result from (1) vascular changes (endarteritis obliterans and thrombosis or embolism of the vessels), with resulting ulceration or the occurrence of gangrenous areas with perforation; or (2) lesions of the nerves, with consequent trophic changes in the bowel walls. Finally, paratyphlitic abscess may occur from the action of a foreign body, particularly a pointed foreign body. The latter usually produces perforation of the bowel wall by the point projecting from a mass of fecal matter or a fecal concretion which has formed with the foreign body as a nucleus. A foreign body with roughened surfaces, such as a gall-stone, may become lodged in the folds of mucous membrane of the cecum, particularly that known as Gerlach's valve, at the appendiculo-cecal orifice, and here produce an abrasion of the mucous membrane, with subsequent infection of the sub-mucous tissue and finally ulceration of the bowel wall, and even sloughing away of the entire appendix at its point of attachment. In a case of this kind coming under my observation at St. Mary's Hospital a ragged hole in the cecum, with gangrenous margins, occupied the site of the base of the appendix.

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[1] Dauber: Über primäre Typhlitis als Ursouche recidivirender Epityphlitis-attacken. Mittheilungen a.d. Grenzgebieten der Medicin u. Chirurgie, Bd. IV, Hft. 3.

In those cases in which no perforation exists, the mechanism of the infection consists in bacterial migration, the causative lesion robbing the intestinal wall of its function of intercepting the passage of infectious agents through its tissues; and in the cases in which perforation exists, in direct infection from contact with the fecal contents of the bowel.

The symptoms of paratyphlitic abscess are the presence of a tumor in the right iliac region, preceded by pain and tenderness in this region. The history usually includes loss of appetite, disturbances of digestion and constipation; following which there has been slight fever, and in some instances vomiting. If the case is one of stercoral typhlitis primarily, and is seen in this stage, a fecal accumulation may be made out as a doughy mass in the neighborhood. Considerable distention may be present. Obstruction beyond that known as fecal impaction is a possible although rather rare occurrence. Localized peritonitis is always present.

The suppurative collection may evacuate itself into the peritoneal cavity, giving rise to diffused septic peritonitis. This is most apt to occur if the abscess is the result of a perforation by a pointed foreign body. Exclusive of this class of cases, the pus finds its way either posteriorly, invading the retroperitoneal connective tissue, and, simulating a perinephritic abscess, follows the space between the lateral abdominal wall and perforates the diaphragm; or it may invade the sheath of the psoas muscle and find its way into the thigh. Flexion of the thigh will then be present. The discharge may take place through the anterior abdominal wall.

In differentiating these cases from appendicitis, the only disease with which the diagnosis may be confounded, its exceptional and even rare occurrence, as compared with the frequency of appendicitis, is to be kept in mind. It is more likely to attack elderly persons, in my experience, than is the latter disease. It is less abrupt in its onset than appendicitis, and the pain is less severe and more distinctly localized from the commencement. The tumor in paratyphlitic abscess in cases of stercoral origin is present from the beginning, while in acute appendicitis this is seen in cases supervening upon a chronic condition, which, as a rule, can be traced to a former attack; a distinct period of from two to four days intervenes between the beginning of the attack and the appearance of the tumor where the latter is appendicular in origin. In typhlitic tumor the mass is somewhat elongated, is situated at the site of the cecum, and can be indented by the finger if tenderness is not too great. It is less tender than the tumor of appendicular origin. The latter is more distinctly below the level of the anterior superior spinous process of the ilium, is less regular in outline, and, unless the symptoms are masked by opium, is exquisitely tender. The rigidity of the lower portion of the rectus abdominis muscle is less marked than in appendicitis.

The differentiation above outlined only holds good prior to the occurrence of suppuration. As a rule, when the latter has taken place attempts to establish a diagnosis will be futile save through an operation. In the simple catarrhal, and even in some cases of the parietal, form of typhlitis the symptoms are promptly and permanently relieved if the bowels are well acted upon by a laxative. Cases of paratyphlitic abscess resulting from ulcerative action, gangrene of the bowel wall, and foreign bodies are usually impossible of differentiation from appendicular lesions; in any event these will require surgical treatment. In case of doubt it is better to treat the case as one of appendicitis.

The prognosis will depend largely upon the course which the pus takes in finding its way externally. Early diagnosis and prompt operative interference may prevent the suppurative process from finding its way into regions inaccessible for purposes of complete drainage after incision.

The treatment will vary with the character of the case. If one of simple stercoral typhilitis, complete rest in bed, the administration of calomel followed by salines, and finally by simple enemas, will be appropriate measures of treatment. The use of an ice-bag locally assists in the relief of pain. The occurrence of localized peritonitis will be announced by the presence of increased tenderness and pain. With the supervention of the latter opium may be given in cautious doses. The persistence of a tumor, with free evacuation of the bowels, increasing pain and tenderness with fluctuating temperature and the other signs of suppuration indicate the necessity for evacuation of the pus. The abscess cavity may sometimes be reached and evacuated without invading the peritoneal cavity by making the incision as if for ligation of the epigastric artery, and crowding back the peritoneal fold, so as to gain access to the inflammatory mass.

In cases with sudden onset, in which perforation has probably occurred in the beginning without the previous formation of adhesions, operative interference should be instituted. *In all cases of doubt no time should be lost in temporizing. The patient's best interests demand that the case be treated surgically, as for appendicitis.*

INDEX.

Abdomen, appearance of, 56.
  auscultation of, 92.
  palpation of, 53, 92, 93.
  preparation of, for operation, 158.
  reopening of, 208.
Abdominal muscles, limitation of movement of, 91.
  wall, nerve and blood supply of, 150.
    relation of appendix to, 151.
    surgical anatomy of, 147.
  wound, closing of, 193.
Abscess, extra-peritoneal rupture of, 57.
  hepatic, 67.
  in abdominal wall, differential diagnosis of, 120.
  of liver, 143.
  para-appendicular, 44.
  paratyphlitic, 217.
  pelvic, 213.
  rupture into anterior abdominal wall, 66, 142.
    into bladder, 57, 65, 141.
    into both intestine and bladder, 65, 141.
    into intestinal canal, 65, 140.
    into large intestine, 141.
    into peritoneal cavity, 65, 140.
    into pleural cavity, 143.
    into post-peritoneal connective tissue, 19, 66, 142.
    into rectum, 57.
    into small intestine, 56.
    into thigh, 57, 66, 142.
Abscess, rupture into vagina, 57, 66, 142.
    through diaphragm, 143.
    through diaphragm and bronchus, 67.
  spontaneous evacuation of, 65, 140.
  symptoms of rupture of, 65.
Actinomyces, a predisposing cause, 74.
Acute appendicitis, 47.
  indigestion, 90.
Adhesions, a cause of post-operative obstruction, 209.
  causing angulation, 131.
  effect of, 40.
  method of dealing with, when obstruction is present, 184.
  prevention of, 189.
  result of repeated relapses, 40.
  to the anterior peritoneum, 174.
  treatment of, 184.
After-treatment of operated cases, 199.
Age as an etiological factor, 77.
Albuminuria, a complication, 56.
Amputation, circular flap, of appendix, 185.
Anastomosis, pathological, 57.
Anatomical considerations, 17.
Angulation of appendix, 39, 41.
    in relation to circulatory disturbances, 38.
    in relation to prognosis, 131.
Anti-streptococcic serum, 207.
Aponeurosis of external oblique, 147.
Appendicectomy, 25, 186.

Appendicitis, abdominal examination in, 93.
  actinomycotic, 74.
  acute, 47, 99.
  after-treatment of, 199.
  bacteriology of, 82.
  chill, significance of, in, 54.
  chronic, 101.
  chronic relapsing, 59.
  clinical history of, 47.
  clinical varieties of, 46.
  complicated by intestinal obstruction, 70.
  complicating pregnancy, 70.
    puerperal state, 70.
  complications of, 62.
    through medium of portal circulation, 67.
  constipation in relation to, 50.
  diagnosis of, 90.
  differential diagnosis of, 102.
      acute, 112.
      chronic, 119.
    length of appendix in, 112.
    summary of most important points, 98.
  typical cases of, 97.
  endo-, 41.
  etiology of, 72.
  first stage of, 41.
  foreign bodies in, 215.
  fourth stage of, 44.
  gangrenous, 42.
  indications for operative interference in, 144.
  indigestion as a cause of, 78.
  in hernial sac, 69.
  irritability of bladder in, 54.
  left-sided, 51.
  nausea and vomiting in, 49.
  para-, 44.
  parietal, 43.
  peri-, 43.
  peritonitis, supervention of, in, 55.
Appendicitis, post-operative complications of, 204.
  prognosis of, 124.
  relapsing, pathological anatomy of, 39.
  retraction of thigh in, 54.
  rigidity of rectus in, 53, 92, 95.
  second stage of, 43.
  special types of, 58.
  subacute, 101.
  suppurative, 44.
  symptoms of chronic relapsing, 59.
    of recurrent, 59.
    of subacute, 58.
  temperature and pulse in, 54.
  termination of, in cases not operated upon, 127.
  third stage of, 43.
  traumatic, 78.
  treatment of, non-operative, 132.
    operative, 144.
  tubo-ovarian lesion in connection with, 94.
  tumor in, 54.
  tympanites in, 53.
  ulcerative, 42.
  value of local symptoms of, 100.
Appendicular colic, 41, 47.
  lesions from foreign bodies, 215.
  lymphatic ganglion, 25.
Appendiculo-ovarian ligament of Clado, 22.
    blood supply through, 24.
    lymphatic channels through, 25.
Appendix vermiformis ceci, 20.
    abnormal situation of, 21.
    acting as constricting band, 30, 108.
    adhesions of, 40.
    amputation of, by circular flap, 185.
      typical, 186.

Appendix vermiformis ceci, angulation of, 38, 39, 41, 131.
  anomalies of, 38.
  bacterial infection of, 39, 75, 82.
  blood supply of, 23.
  blood-vessels of, 24.
  carcinoma of, 121.
  catarrhal inflammation of, 38.
  circulation of, 24.
  circulatory disturbances of, 38.
  classification of lesions of, 38.
    of position of, 26, 28.
  coagulation necrosis of, 39.
  coats of, 22.
  collateral circulation of, 24.
  constriction of calibre of, 41.
  cul-de-sac of, 23.
  development of, 31.
  direction of, 26, 28.
  disposition of, 184.
  disturbances of circulation of, 38, 39.
  enterolith in, 72.
  evolution, retrograde, of, 75.
  expulsive power of, 73.
  fetal type of, 20.
  fibrinous inflammation of, 38.
  foreign bodies in, 38, 72, 215.
  function of, 31.
  glands of, 23.
  histology of, 23.
  hyperemia of, 38, 39, 40.
  hyperplasia of, 38, 39, 40.
  inflammations of, types of, 38.
  inflammatory lesions of, 36.
  ligature of, 184, 185.
Appendix vermiformis ceci, ligature of, temporary, 189.
  lumen of, 23.
  lymphatics of, 25.
  lymphoid tissue of, 23.
  measurements of, 21.
  mesentery of, 21.
  method of search for, during operation, 183.
  mobility of, 38.
  mucous coat of, 23.
  muscular coat of, 22.
  nerves of, 25.
  non-descent of, 21.
  non-specific inflammation of, 38.
  normal position of, 20.
  nutrient artery of, 24.
  nutrition, disturbances of, 38.
  oligemia, 38.
  palpation of, 93.
    through rectum, 94.
  parasites in, 39.
  partial removal of, 184.
  pathology of, 37.
  perforation of, by pin, 215, 216.
  peritoneal covering of, 22.
  purse-string suture of, 186, 188.
  purulent foci in wall of, 39.
    inflammation of, 38.
  relation of, to abdominal wall, 151.
    to cecum, 25.
    in its various positions, 28, 30.
  relative size of, in infant and adult, 31.
  retrograde evolution of, 75.
  shape of, 22.
  specific inflammation of, 38.
  structure of, 22.
  submucous coat of, 22.
  surface relations of, 151.

- Appendix vermiformis ceci, torsion of, 81.
  - trophic disturbances in, 39.
  - tubercular inflammation of, 38.
  - typical excision of, 186.
  - usual attachment of, 20.
  - valve of, 23.
  - variations in attachment to cecum of, 20.
    - in positions of, 28, 30.
    - in vital resistance, 61.
  - vascular obstruction in, 39.
- Arnold's steam sterilizer, 163.
- Articles to be steam sterilized, 163.
- Auscultation of abdomen, 92.

- Bacillus coli communis, 62.
  - Barbacci's conclusion as to, 84.
  - effect on other bacteria, 84.
  - in pure culture in appendicitis, 83.
  - in relation to appendicitis, 83.
  - not the sole infecting agent, 84, 88.
  - results of bacteriological examinations of, 88.
    - of inoculation in animals with, 83, 84.
- Bacillus pyocyaneus of Gessard, 213.
- Bacillus pyogenes fetidus, 86.
- Bacteria in exudate of perforative peritonitis, 85.
- Bacterial infection of the appendix, 39, 75, 82.
- Bacteriological considerations, 82.
  - examinations, conclusions of, 88.
    - technique of, 85.
- Barrel-shaped abdomen, significance of, 91.
- Bladder, irritability of, in appendicitis, 54.
  - rupture of abscess into, 57, 65, 141.
- Blood supply of the appendix, 23.
  - as a cause of inflammation, 76.
  - disturbances of, as an etiological factor of appendicitis, 81.
  - relation of, to appendicitis, 76.
  - through appendiculo-ovarian ligament, 24.
- Blood-vessels of appendix, 24.
- Boiling as a means of sterilization, 162.
- Boro-salicylic solution, composition of, 158.
- Bowels, conditions of, prior to attack, 77.

- Caput cecum coli, anatomy of, 17.
  - location of, 17.
- Carcinoma in ileo-cecal region, differential diagnosis of, 121.
  - primary, of appendix, 121.
- Cases, bacteriological findings in, 86.
- Catgut, preparation of, 160.
- Cathartics, use of, after operation, 201, 202.
  - in diffuse septic peritonitis, 207.
- Cecum, abnormally placed, case of, 95.
  - as the primary seat of inflammation, 80.
  - comparative anatomy of, 32.
  - direction of, 18.
  - location of, 17.
  - longitudinal bands of, 183.
  - non-descent of, 21, 94.
  - of monkey, 33.

Cecum, position of, in intra-uterine life, 17.
  relation of appendix to, 25.
  topographical anatomy of, 19.
  variations in position of, 17.
Chill, frequency of occurrence of, 54.
  its diagnostic value, 97.
  significance of, 54.
Chronic relapsing appendicitis, 59.
    non-operative prognosis in, 129.
    post-operative prognosis in, 129.
Circulation of appendix, 24.
Circulatory disturbances, 38, 39, 43.
Clado's ligament, 22.
Classification of direction of appendix, 26.
  of position of appendix, 26, 28.
Clinical history of acute appendicitis, 47.
Closing of abdominal wound, 193.
Coagulation necrosis of appendix, 39.
Colic, appendicular, 41, 47.
  hepatic, differential diagnosis of, 102.
  nephritic, differential diagnosis of, 103.
  painter's, differential diagnosis of, 106.
Communication between appendix and ileum, 57.
Complications of appendicitis, 62.
  post-operative, 204.
  through medium of portal circulation, 67.
  treatment of, 137.
Conclusions of bacteriological examinations, 88.
Connective tissue, coat of appendix, 22.
    post-peritoneal, 19.
    retro-cecal, 19.
Constipation, significance of, 50.
Constriction of calibre of appendix, 41.
Convalescence complicated by intestinal obstruction, 208.
  length of time of, 199.
Coproliths in appendix, 80.
Crin-de-Florence, 161.
Crossed suture, advantages of, 196.
    description of, 194.
    method of securing, 194.
    removal of, 196.
Cul-de-sac of appendix, 23.

Death, mode of, 128.
Diagnosis of appendicitis, 90.
Diet after operation, 200.
  before operation, 158.
Differential diagnosis of abscess in abdominal wall, 120.
    of acute intestinal obstruction, 106, 114.
    of acute peritonitis, 118.
    of acute torsion of right ovarian cystoma, 117.
    of appendicitis, 102.
    of carcinoma in the ileocecal region, 121.
    of extra-uterine pregnancy, 111.
    of fecal impaction, 120.
    of floating kidney, 105, 119.
    of gall-bladder lesions, 102, 114.
    of hepatic colic, 102.
    of ileus, 108, 109.
    of impacted gall-stone in cystic duct, 103.
    of impacted ureteral calculus, 120.
    of internal hernia, 107, 108.
    of invagination, 108, 109.
    of morbus coxarius, 112.
    of nephritic colic, 103.
    of painter's colic, 106.

Differential diagnosis of pelvic hematocele, 111, 117.
    of peri-typhlitis and paratyphlitis, 115, 220.
    of retro-peritoneal sarcoma presenting in the right iliac fossa, 122.
    of right-sided hematosalpinx, 118.
    of rupture of gall-bladder, 105.
    of ruptured ectopic gestation, 117.
    of ruptured ovarian cystoma, 116.
    of ruptured pyosalpinx, 116.
    of subphrenic peritonitis, 113.
    of torsion of right-sided hydrosalpinx, 117.
    of tubo-ovarian inflammatory lesions, 110, 121.
    of typhoid fever and entero-colitis, 112.
    of unusual conditions, 111.
Diffused peritonitis, 44.
  septic peritonitis, appearance of abdomen in, 56.
Diplococcus lanceolatus, 88.
Direction of appendix, 26.
Disinfection of surgeon and assistants, 164.
Distention due to opium, 91.
  paretic, of intestine, 53.
  progressive abdominal, 91.
  treatment of, 201.
Diverticulum (Meckel's) producing intestinal obstruction, 107.
Drainage by glass tubes, 191.
  by Mikulicz wick drains, 191.
  gauze, 191.
  in appendicular abscess, 192.
  indication for, 190.
  in septic peritonitis, 191.
  in treatment of peritonitis, 139.
Drainage, lumbar, 192.
  methods of, 191.
  removal of, 202.
  through intestinal canal, 207.
  through vagina, 191.
  tubes, precautions to be employed, 139.
Dressings, change of, 202, 203.
  materials for, 161.
  sterilization of, 163.
Dropsy of gall-bladder, differential diagnosis of, 103, 104, 114.

Embolism, septic, in appendicitis, 43.
Encysted intraperitoneal foci, 45, 56.
Endarteritis obliterans of nutrient vessels of appendix, 43.
Endo-appendicitis, 41.
  prognosis in, 124.
Endovasculitis in meso-appendix, 39.
Enema, nutrient, 201.
    indications for, 201.
Entero-colitis, differential diagnosis of, 112.
Enteroliths in appendix, 72.
Erratic peristalsis as an etiological factor, 79.
Etiology of appendicitis, 72.
Eventration in the treatment of diffuse peritonitis, 138, 208.
Evolution, retrograde, of appendix, 75.
Examination, method of, 93.
  rectal, value of, 94.
  vaginal, value of, 94.
Exploratory laparotomy, 94.
  puncture, 96.
Expulsive power of appendix, 73.
Extra-uterine pregnancy, differential diagnosis of, 111.

Fecal communication, 209.
  fistula, 209.
  impaction simulating tumor, 96.

Fecal impaction simulating tumor, differential diagnosis of, 120.
  masses in appendix, 72.
    as a cause of inflammation, 73, 74.
    in subacute cases, 58, 101.
Fecaloid vomiting, 50.
Fetal type of appendix, 20.
Fever, diagnostic value of, 96.
  in subacute form, 58.
Field of operation, final preparation of, 165.
Flap amputation of appendix, 185.
Floating kidney, differential diagnosis of, 105, 119.
Fluctuation, 95.
Foreign bodies in appendix, 23, 38, 72, 73, 215.
Fossa duodeno-jejunalis, hernia into, 107.
Fractional sterilization, 162.
Function of appendix, 31.

Gall-bladder lesion, differential diagnosis of, 102, 103, 104, 114.
  rupture of, differential diagnosis of, 105.
Gall-stone, impacted, differential diagnosis of, 103.
  in appendix, 72.
Ganglion, appendicular lymphatic, 25.
Gangrenous inflammation of appendix, 42.
Gauze drainage, 191.
Gerlach's valve, 23.
Glandular structure of appendix, 23.

Hagedorn needle, modification of, 160.
Hands, disinfection of, 164.
Hematosalpinx, right-sided, differential diagnosis of, 118.
Hemorrhage from gangrenous involvement of the iliac vein, 214.
Hepatic abscess, 67.
  colic, differential diagnosis of, 102, 103.
Hepatitis, septic, 143.
Hernia, internal, differential diagnosis of, 107.
  ventral, 211.
Hernial sac, appendicitis in, 69.
Hiccough, 50.
History, clinical, of acute appendicitis, 47.
Hydrosalpinx, torsion of right-sided, differential diagnosis of, 117.
Hyperemia of appendix, 38, 39, 40.
Hyperplasia of appendix, 38, 39, 40.

Ice-coil, use of, after operation, 205, 207.
Ileus, differential diagnosis of, 108, 109.
  in relation to prognosis, 131.
Iliac fossa, bulging of, 54, 91.
    tumor of, 54.
  phlebitis, 68.
    with thrombosis, 68.
  phlegmon, 19, 44.
    relation to iliac vessels, 20.
  vein, gangrenous involvement of, 214.
Imprisoned fecal masses, 58, 72, 73, 74, 101.
Incision, lumbar, 170.
  oblique, 170.
  selection of, 165.
  skin, in intermuscular operation, 170, 177.
  vertical, 180.
Indications for operative interference, 144.
Indigestion as an etiological factor, 78.
Infection, bacterial, the primary cause, 75, 89.
  microbic, 89.
  of exudate, 44.

Infection, results of, 44.
Infective material, care of, during operation, 183.
Inflammation, catarrhal, of the appendix, 38.
    fibrinous, 38.
    non-specific, 38.
    purulent, 38.
    specific, 38.
    tubercular, 38.
Inflammatory lesions of the appendix, 36.
Inspissated fecal matter as a cause of appendicitis, 73.
Instruments required, 159.
    sterilization of, 161.
Intermuscular methods, 176.
        author's, 177.
        closing of, 197.
        drainage in, 192.
Internal hernia, differential diagnosis of, 107, 108.
    oblique muscle, 148.
Intestinal canal, rupture of abscess into, 65.
    micro-organisms in their relation to appendicitis, 82.
    obstruction, acute, differential diagnosis of, 106, 114.
        chronic, differential diagnosis of, 109.
        complicating appendicitis, 70.
        post-operative, 208.
    paresis, 207.
Intracuticular suture, 196.
Intravenous saline infusion, 208.
        in connection with strychnia, 208.
Invagination, differential diagnosis of, 108, 109.
Irritability of bladder, 54.
Isolation of intra-abdominal operating-field, 181.

Kidney, floating, differential diagnosis of, 105, 119.

Lavage in diffuse septic peritonitis, 203.
    in post-operative treatment, 200.
Left-sided appendicitis, 51.
Lesions of appendix, classification of, 38.
Leucocytes, germicidal power of, 205.
Leucocytosis, diagnostic value of, 97.
    effect of saline solutions upon, 208.
Ligament, appendiculo-ovarian, of Clado, 22.
    blood supply through, 24.
    lymphatic channels through, 25.
Ligature of appendix, 184, 185.
        temporary, 189.
    material, 160.
Line, omphalo-spinous, 50.
Location of appendix, 25.
    of cecum, 17.
    of primary pain, 48.
Lumbar drainage, 192.
    phlegmon, 45.
    tenderness, 51, 96.
Lumen, occlusion of, 75.
Lymphatic ganglion of appendix, 25.
Lymphatics of the appendix, 25.
Lymphoid tissue of appendix, 23.

Macrophages of Metchnikoff, 205, 208.
Magnesium sulphate, administration of, 202.
McBurney's point, 51.
Mesenteric thrombo-phlebitis, 67.
Meso-appendix, 21.
    endovasculitis in, 39.
    final disposition of, 189.
    ligature of, 185, 186.
    method of dealing with, 185, 186, 189.
    paravasculitis in, 39.

Meso-appendix, perivasculitis in, 39.
  torsion of, 38.
  vessels of, 39.
Meso-cecum, 19.
Microbic infection of the appendix, 89.
Micrococcus flavus liquefaciens, 87.
  lanceolatus, 84.
Micro-organisms, a caùse of inflammation, 74.
  as infective agents, 44.
Mikulicz's wick drains, 191.
Mobility of the appendix, 38.
Monkey, large intestine of, 33.
Morbus coxarius, differential diagnosis of, 112.
Mucous membrane, destruction of,
    by carbolic acid, 185.
    by nitric acid, 184, 185.
    by thermo-cautery, 184, 185, 188.
  swelling of, as a cause of gangrene, 41.
Mucous sinus, 211.
Muscular fibres of appendix, circular, 22.
  absence of, 73, 81.

Nausea as an early symptom, 49.
  relief of, after operation, 200.
Necrosis of the mucosa, 39, 42.
Nerve and blood supply of abdominal wall, 150.
Nerves of appendix, 25.
Neuritis, chronic interstitial, 39.
Non-operative treatment, cases suitable for, 132.
Nutrient artery of appendix, 24.
  vessels, occlusion of, as a cause of gangrene, 42.
Nutrition disturbances, progressive, in appendix, 38.
Nutritive disturbances, regressive, in appendix, 38.

Oblique incision, 170.
  method of closing, 193.
Obstruction of bowels due to appendix acting as a band, 108.
Occlusion of lumen of appendix, 75.
Oligemia of appendix, 38.
Omphalo-spinous line, 50.
Operating-table, Delatour's, 155.
  Förster's, 154, 155.
  preparation of, 156.
Operative interference, indications for, 144.
  treatment, 144.
Opium, justifiability in use of, 134.
  masking symptoms, 91, 99, 100, 134.
  value of, in non-operative treatment, 144.
Ovarian cystoma, acute torsion of right, differential diagnosis of, 117.
    ruptured, differential diagnosis of, 116.

Pain, character and location of, in acute cases, 99.
  in subacute form, 58.
  location of primary, 48.
  mechanism of production of, 48, 49.
  reason for general dissemination of, 25.
Palpation of abdomen, 53, 92, 93.
  of appendix, 93.
  to determine tenderness, 53.
Paralysis of peristalsis, 64.
Paranephritic abscess, 45.
Parasites in the appendix, 39.
Paratyphlitic abscess, 217.
    modes of termination of, 219.
Paratyphlitis, 36.
  differential diagnosis of, 115, 220.
  treatment of, 220.
Paravasculitis in meso-appendix, 39.

Paresis, intestinal, 91.
Parietal appendicitis, 43.
Partial removal of appendix, 184.
Pathology of appendix, 37.
Patient, preparation of, 158.
Pelvic abscess, 213.
  hematocele, differential diagnosis of, 111, 117.
Percussion, 96.
Peri-appendicitis, 43.
Pericarditis, purulent, 68.
  suppurative, 143.
Peristalsis, erratic, as cause of appendicitis, 79.
Peritoneal cavity, flushing of, 208.
  stage of Talamon, 125.
Peritoneum, incision of, 174, 179, 181.
Peritonitis, a complication, 62.
  acute, differential diagnosis of, 118.
  diffused, 44.
    manner of dealing with, 189.
  diffuse septic, 55.
  drainage in, 139, 191.
  elevated head-and-trunk position in treatment of, 139.
  encysted, septic foci in, 45.
  eventration in treatment of, 138.
  fecal fistula in tubercular, 140.
  infectious, 63.
    symptoms and course of, 64.
  perforative, 62.
    symptoms and course of, 64.
  post-operative, 204.
  prognosis in, 130.
  septic, 45.
    as a post-operative complication, 205.
      treatment of, 207.
      use of opium in, 208.
    lavage in, 203.
Peritonitis, septic, treatment of, 203.
  suppurative, 44.
    progressive, 45.
  treatment, 137.
    in limited cases, 139.
  tubercular, 63.
    treatment of, 140.
Perityphlitis, 36, 80, 217.
  differential diagnosis of, 115, 220.
  treatment of, 220.
Perivasculitis in meso-appendix, 39.
Phlebitis, iliac, 68.
  of appendicular vessels, 42.
  with thrombosis of iliac vein, 68.
Phlegmon, dorso-lumbar, 66.
  iliac, 19, 44.
  lumbar, 66.
Pin in appendix, 215.
Pleuritis, purulent, 68.
Point of tenderness, 93, 94.
Portal circulation, complications arising through medium of, 67.
Position of patient on operating-table, 165.
Post-laparotomy pill, 203.
Post-peritoneal abscess, tendency of, to spread, 45.
  connective tissue, infection of, 66.
Posture, elevated head-and-trunk, 204.
  in doubtful cases, 165.
  in treatment of diffused septic peritonitis, 207, 208.
  in treatment of peritonitis, 139.
  Trendelenburg, 155.
Pregnancy, complicated by appendicitis, 70.
  ectopic, ruptured, differential diagnosis of, 117.
  extra-uterine, differential diagnosis of, 111.
Preparation for the operation, 152.

Preparation of patient, 158.
  of room for operation, 153.
Prognosis in appendicitis, 124.
  in cases not operated upon, 126, 127.
  in cases of perforation, 129.
  in cases of peritonitis, 130.
  in cases operated upon, 128.
  in endo-appendicitis, 124.
  in subacute cases, 126.
  non-operative, in chronic relapsing cases, 129.
  post-operative, in chronic relapsing cases, 128.
Puerperal state complicated by appendicitis, 70.
Pulse, effect of opium on, 100.
  in acute attack, 100.
  in diffused septic peritonitis, 55.
Puncture, exploratory, 96.
Purse-string suture of appendix, 186, 188.
  of peritoneum, 196.
Purulent foci, in wall of appendix, 39.
Pus, removal of, during operation, 182.
Pylephlebitis, 67.
Pyosalpinx, ruptured, differential diagnosis of, 116.

Rectal palpation, 94.
  temperature as a diagnostic aid, 97.
  tube, use of, 200, 202.
Rectum, rupture of abscess into, 57.
Rectus muscle, 149.
  rigidity of, 53, 92, 95, 99.
Recurrent appendicitis, 59.
Reinfection of abscess through communication with bowel, 57.
Relapsing, chronic, appendicitis, 59.
  pathology of, 39.
Relations of appendix in its various positions, 30.
Relative size of appendix in infant and adult, 31.
Rigidity, effect of opium on, 100.
  in extensive peritoneal infection, 100.
  method of determining, 99.
  of right rectus muscle, 53, 92, 95, 99.
Report of bacteriological examinations in specific cases, 86.
Respiration, character of, 91.
Responsibility, division of, 144.
Retraction of the incision, 182.
Retro-cecal connective tissue, 19.
Retrograde evolution of appendix, 75.
Retro-peritoneal connective tissue, infection of, 44.
  sarcoma, differential diagnosis of, 122.
Room, selection and preparation of, for operation, 153.
Rupture of abscess, see Abscess, rupture of.

Sarcoma, retro-peritoneal, differential diagnosis of, 122.
Sausage-shaped tumor of Treves, 94.
Secretions of appendix as a culture medium, 75.
Seeds in appendix, 72.
Selection of room for operation, 153.
Septic pneumonia, 69.
  thrombosis, 42.
Serum as a culture medium, 45.
Sex as an etiological factor, 78.
Shape and position of the appendix as a predisposing cause of inflammation, 76.
Silk, preparation of, 160.
Silkworm-gut, preparation of, 161.
Skin, preparation of, 158.

Sponges and dressing materials, 161.
    sterilization of, 163.
Spontaneous evacuation of abscess, 65.
    treatment of, 140.
Stage of appendicitis, first, 41.
    fourth, 44.
    second, 43.
    third, 43.
Steam sterilization, 163.
Stenosis of canal of appendix, 75, 76.
Stercoral typhlitis, 37.
Stercoremia, 128.
Sterilization of dressing and sponge materials, 163.
    of instruments, 161.
Stimulants, use of, before operation, 159.
Strangulation of intestine by appendix, 30.
Streptococcus pyogenes, 88.
Structure of appendix, 22.
Subacute appendicitis, 58.
    pathology of, 39.
    prognosis in, 126.
Subphrenic abscess, 45.
    peritonitis, differential diagnosis of, 113.
Summary of bacteriological investigation, 88.
    of causes, 81.
    of important diagnostic points, 90.

Suppurative appendicitis, 44.
    peritonitis, 44.
Suture, crossed, 194.
        removal of, 196.
    intracuticular, 196.
    provisional, 203.
    purse-string, of appendix, 186, 188.
        of peritoneum, 196.
    secondary, 202.
Technique in dealing with diffuse septic peritonitis, 189.
    intra-abdominal, 181.
    of bacteriological examination, 85.
    of disposition of the appendix, 184.
    of isolation of intra-abdominal operating-field, 181.
    of search for the appendix, 183.
    of typical excision of the appendix, 186.
Temperature, effect of opium on, 100.
    in acute cases, 100.
    in appendicitis, 55.
    in diffuse septic peritonitis, 55.
    in subacute form, 58.
    rectal, as a diagnostic aid, 97.
Tenderness, as an aid to prognosis, 126.
    due to adhesions, 93.
    due to impacted feces, 96.
    early elicitation of, 51.
    in acute cases, 99.
    in chronic relapsing form, 59.
    in subacute form, 58.
    location of, 50, 51, 92, 93, 94.
    lumbar, 51, 96.
    pathognomonic of appendicitis, 92.
Termination, mode of, 127.
Thiersch's solution, composition of, 158.
Thigh, flexion of, 54, 91.
    retraction of, 54.
    rupture of abscess into, 57.
Thrombo-phlebitis, 210, 211.
Thrombosis in vessels of meso-appendix, 39.
    of iliac vein, 68.
Topographical anatomy of cecum, 19.
Torsion of the appendix, 81.
Toxic properties of micro-organisms of diarrheal diseases, 79.
Transversalis muscle, 148.

Traumatic appendicitis, 78.
Traumatism as an etiological factor, 78.
Treatment, antipyretics in, 136.
  cathartics in, 133, 136.
  diet in, 136.
  during period of localized peritonitis, 146.
  in cases of doubtful diagnosis, 147.
  in diffuse septic peritonitis, 146.
  local applications in, 135.
  non-operative, 132.
  of complications, 137.
  operative, indications for, 144.
  post-operative, 199.
  rules for, 145.
  use of opium in, 134, 135.
Trendelenburg's position, 155.
    contraindications, 156.
Triangles of the abdomen, 122.
Trophic disturbances in appendix, 39.
Tubercular inflammation of appendix, 38, 63.
  ulcers a predisposing cause, 74.
Tubo-ovarian inflammatory lesions, differential diagnosis of, 110, 121.
Tumor due to impacted feces, 96.
  early appearance of, 95.
  in chronic relapsing form, 59.
  in right iliac fossa, 54.
  in the female, 95.
  location of, in acute cases, 100.
  movable, 100.
  presence of, 95.
  time of appearance of, 100.
Tympanites in acute attack, 53.
Types, special, 58.
Typhlitis, 36, 80, 217.
  gangrenous, 189.
  stercoral, 217.
Typhlo-enteritis, 37.
Typhoid fever, differential diagnosis of, 112.
Typical excision of the appendix, 186.
    modification of, 189.

Ulcerative appendicitis, 42.
Umbilicus, care in preparation of, 165.

Vagina, drainage through, 170.
  rupture of abscess into, 57, 66.
Vaginal examination, value of, 94.
Valve of Gerlach, 23.
Vascular obstruction in the appendix, 39.
Ventral hernia, 211.
Vertical incision, 180.
    closing of, 198.
Vomiting as an early symptom, 49.
  character of, 49.
  fecaloid, 50.
  in acute cases, 99.
  in cases of perforation, 50.
  persistence of, 49.
  treatment of, 200.
Vomitus, character of, 49.

Whitehead's varnish, 165.
Wick drains of Mikulicz, 191.
Woefler's mixture, 165.
Wound complications, 212.

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